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By

Melvin Weiner

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Psychological Monographs: General and Applied

Perceptual Development in a Distorted Room: A Phenomenological Study[1]

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The Menninger Foundation[2]

I. INTRODUCTION

THIS study is concerned with a series of investigations on the development of perception in adults. The literature on developmental problems with adults is scanty, though Ames (1, 2) and Kilpatrick (10) have recently carried out a series of experiments in perceptual learning. Their goal has been to focus on changes in perception brought about by certain controlled laboratory experiences. The experiments by Kilpatrick, utilizing the Ames distorted room, are noteworthy, and have been of help in the design of this investigation. In the field of child psychology, the pioneering work of Piaget (e.g., 15, 16) on developmental problems stands out. His theoretical formulations serve to stimulate experimental studies by giving them a focus and a deeper meaning.

In the present investigation we shall explore such questions as these: How do adults perceptually construct reality? How do adults become more coordinated with their surroundings and develop veridical (i.e., environment-adequate) perception? We designed an "experimental world" where the individual's environment is new and strange to him, and where the application of old habitual ways of acting and perceiving is inadequate. For the individual to adapt his perceptions so that they are coordinated with the new environment that we devise, he has to develop new ways of perceptual functioning and new percepts. He has to learn from his contact and interaction with his new environment, and has to integrate these new experiences into his perceptual functioning. The plan is to obtain a careful, detailed phenomenological record from *S* in his attempts to adjust to this new world through the development and emergence of new percepts.

The "experimental world" consists of a specially designed room which is perceived as a "square" room, even though it is objectively distorted. In addition, when real-life objects and people are placed within this room, the objects and people themselves are perceived as distorted. The room is so designed that the rear wall, instead of being square, with rectangular windows, and in the frontal plane (as in everyday rooms), is trapezoidal in shape with trapezoidal win-

[1] Based on a dissertation submitted to the department of psychology of the University of Kansas in partial fulfilment of the requirements for the Ph.D. degree. The experiments were carried out in the department of research of The Menninger Foundation, for which grateful acknowledgment is due The Menninger Foundation and the National Institutes of Health, USPHS, for their support of this research. It is also a pleasure to acknowledge the encouragement and advice of Drs. Alfred L. Baldwin, Fritz Heider, and Gardner Murphy.

[2] Now at the Laboratory of Psychology, University of Geneva, Geneva, Switzerland.

dows, and is tilted out of the frontal plane.

Thus we set up a situation where a disequilibrium exists between the individual and his environment. On the one hand, the observer perceives the room as square, while the room is objectively distorted. On the other hand, objects are perceived as distorted to "fit in" with the perceived squareness of the room. There is a lack of correspondence between the appearance of the objects and room and their objective nature in the environment.

What we are concerned with is to attempt to provide *S* with the opportunity to experience new relationships of objects and surroundings, so that he may develop a new perceptual adaptation to the "experimental world" which we have provided for him. Given the opportunity to view stationary and moving objects from varying perspectives, and to have motoric contact with the room by touching various parts of the room with a stick, the questions we first raise are these: How does *S* learn to perceive the room as it objectively is? How does the observer learn to integrate new experiences into his existing mode of perceiving, and thus establish a new adaptive equilibrium freed from distortion?

The next problem is this: What is the nature of the perceptual development? In other words, what has *S* learned? Under what conditions does *S* learn a *specific* perceptual response when a particular stimulus distribution is produced on the retina? Or, under what conditions does *S* learn a *generalized and transposable* environment—adequate perceptual orientation, in which he would be able to perceive the objective nature of various distorted "experimental worlds?" To test the generality of learning, in this part of the research the observer is presented with a differently-shaped distorted room, but having a projection equivalent to that of the first distorted room. The question is: How does *S* perceive this distorted room after having adequately learned to perceive the objective nature of a differently-shaped distorted room? If objects are then introduced, does the individual maintain a constant relationship to object-characteristics? Would this second distorted room then be organized in terms of the stable and enduring characteristics of the objects within it? Or would *S* have to learn again step by step to perceive the constancy of objects and the objective nature of the second room's distortion? If *S* learns a generalized object-framework relationship, we would expect him to carry over a new way of perceiving that would short-cut a tedious relearning process. Objects should then be perceived as invariant, and the second distorted room should be perceived as it really is in a shorter time. A newly-developed generalized way of perceiving should provide for a general adaptive orientation, which should survive multiple transformations, and should be applicable to the new situation of the second distorted room.

II. Apparatus

The experimental distorted room is a specially constructed room which, when viewed monocularly from the viewing point, appears to be cubical in shape, with 4-foot sides and solid right-angled corners and rectangular windows of equal size (see Figs. 1 and 2). Objectively, however, the back wall of the room is distorted; i.e., the room consists of a "normal" cubical section of square side walls, ceiling, and floor, and a "distorted" back wall section. The back wall and windows are trapezoidal in shape and tilted out of the frontal plane (see Figs. 3 and 4).

There were four principal reasons for

designing the kind of distorted room utilized in the present study. 1. We wanted a design that would facilitate methodological clarity in terms of more adequately representing the nature of the change in perception. The previously existing rooms, being designed with the distortion on all sides (the floor, ceiling, left and right walls, and the back wall), create a problem in design and measurement. With a room distorted on all sides the perception of the room does not change as a whole, and consequently, different parts of the room do not change at the same rate or in the same sequence. Since perception change in any particular part of the room is not an index of the total change, but an index of change only in that part, it is insensitive to both the total amount of change and the nature of the developmental sequence of the change. For example, *S* may perceive a slant in the rear wall. But then, instead of a further change in the rear wall, forward or backward, *S* may perceive some slant in the ceiling. Perhaps there follows a perceived slant in the floor. Then *S* may perceive even less slant in the ceiling, and so on. The manifest sequence of development therefore may not truly reflect the actual development, since while it may seem that no change or even a decrease in the slant of the rear wall may reflect a standstill or regression in development, very rapid and important progress may be going on when other parts of the room are considered. The results derived from such a distorted room may lead to conclusions which are vitiated by the inconsistencies in the perceptual changes in the different parts of the room. The room designed for the present study overcomes these difficulties,

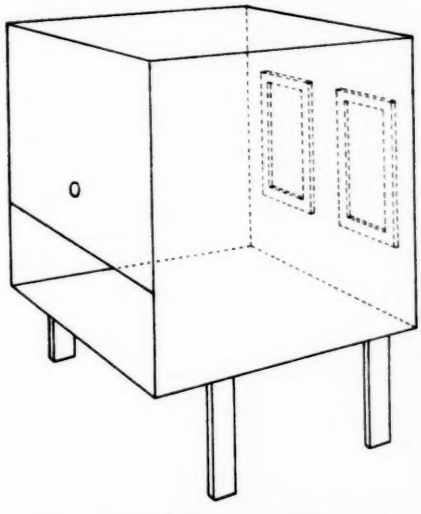

FIG. 1. The phenomenal appearance of the distorted room: perspective view.

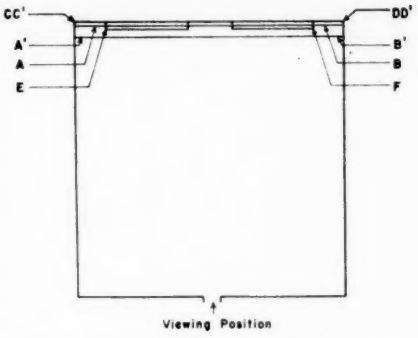

FIG. 2. The phenomenal appearance of the distorted room: plan view.

Explanation of symbols:

A. Left end of movable cable attached to back wall section.
A'. Left end of movable cable attached to cubical section.
B. Right end of movable cable attached to back wall section.
B'. Right end of movable cable attached to cubical section.
C. Upper left corner of back wall where it meets cubical section.
C'. Upper left corner of cubical section.
D. Upper right corner of back wall where it meets (in projection) cubical section.
D'. Upper right corner of cubical section.
E. Upper left corner of left window frame of back wall.
F. Upper right corner of right window frame of back wall.

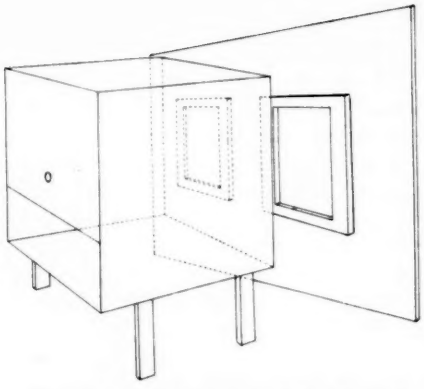

FIG. 3. The objective nature of the distorted room: perspective view, Room 1.

so that more reliable and consistent measurements may be made. By distorting the room in one plane, perceptual change in the distorted plane is a more complete index of the total change, and more directly reflects the sequence and alteration in perception as it occurs. This is not to deny that a room distorted on all planes may be valuable, since investigation of how part-perceptions are integrated is worth while in its own right.

2. We wanted to design a room where overlay cues could be utilized, thus greatly increasing the lifelikeness of the room. The present room is designed to look as if there were a corner where the walls came together, but where objectively there was empty space where the corner was supposed to be. This seems paradoxical, but Fig. 4 indicates that there is a gap between the back wall and the floor, the ceiling and the right side wall.

3. Rooms in everyday life are not just "four walls," but "four walls surrounding objects." Thus, a design was required in which a variety of objects and people could be easily set up and moved about by both *E* and *S*. It is through the gap that objects can be easily introduced and manipulated. In this respect the design of the experiment becomes basically different in focus from previous investigations. In the present experiment, because of the presence of objects in the room we may be able to examine the nature of the relationships between objects and their spatial framework, whereas in previous investigations (10), because *S* was provided with only a stick and rubber balls to be pointed and thrown at various parts of the room, the object-framework aspects of perceptual functioning were not emphasized. Thus, as in the emphasis given by Gibson (6) and Koffka (12), our focus shall be on the interrelationships between the objects-in-space and their spatial framework.

4. Finally, we wanted to design a room which would be relatively simple in construction (the distortion is designed on only one plane, while the main section remains a cube) and flexible in utilization (i.e., the same cubical section can be converted for use with several differently-shaped distorted sections).

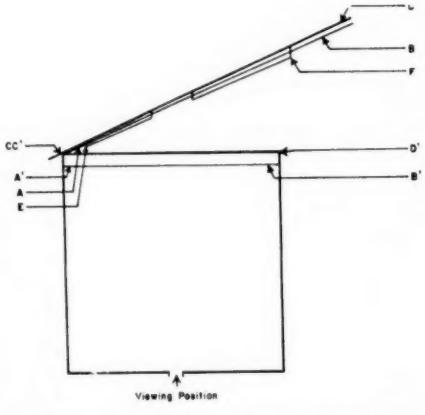

FIG. 4. The objective nature of the distorted room: plan view. Room 1. (See Fig. 2 for explanation of symbols.)

III. Experimental Procedure

A. Experimental Setup

The *S* is brought into the laboratory with a patch over his left eye. He is seated in front of the viewing position of the distorted room, without having been able to see any part of the room or the laboratory. The *S* places his head in an adjustable headrest in such a position that his right eye is at the projection point. He is then asked to open his eyes. Since a patch is over his left eye, he views the room monocularly. After *S* has had an opportunity to observe the room *E* asks, "What do you see?" and follows up *S*'s responses with, "How does it look?" "Can you describe it (more fully)?" "Is there anything else?"

B. Training Procedure

After this initial description of the room is obtained, objects are introduced by *E* to fit the needs of what may be called a training program. Each object is devised and introduced into the room in such a way as to be perceived differently, depending on the objective nature of the distortion of the room. In this manner *S* could be presented with *perceptual information,* and not just intellectual information, concerning the objective structure of the room. The introduction of objects in the experiment does not, however, imply training in the ordinary sense of the word, where the trainee may be a passive observer of a regimen of training activities, and in which he merely attempts to incorporate or integrate a certain amount of new information in his repertory of behavioral adjustments. In this experiment the various objects or cues provided in the training series are not immediately perceived by *S* as cues. In fact, not only is the cue-value of the object not immediately apparent to *S*, but the cues present a conflict for *S* and set up contradictions that have to be resolved. The *S* must, through active participation, actually discover or disclose perceptually what the cue-value is; in other words, he has to learn to utilize the objects as cues. Only in this sense can the objects introduced into the room be considered to involve training. Thus, a variety of everyday objects as well as people are introduced in the experiment to serve as cues, and will be referred to as cue-demonstrations. It was expected that the richness of the objects would not only increase the lifelikeness-character of the experiment, but also increase the potency of the objects as cues.

An example of how a cue-demonstration functions is the following:

In the early stages of *S*'s viewing of the objects in the room, the objects are perceived as distorted (e.g., people seem to walk through solid walls, cigarette packages seem to shrink in size, and marbles seem to roll uphill, etc.), while the room is perceived as perfectly "normal," regular, and lifelike. But after varied experiences with the cue-demonstrations (e.g., *S* is given opportunity to view the cigarette packages moving across the room in various directions), the perception of the objects in the room begins to change, and concomitantly, the objects begin to serve as cues for the objective nature of the room. For example, no longer does the cigarette package look as if it were shrinking in size as it moves across the distorted rear wall. Coordinate with the cigarette package's being perceived as remaining the same size, it comes to serve perceptually as a cue to distance. Then, parts of the rear wall begin to be perceived as they really are; i.e., as distorted, irregular, and not like parts of a real-life room. It should be noted, therefore, that each cue demonstration serves a dual

purpose: *first*, that of providing *S* with perceptual cues for the objective nature of the distorted room, and *second*, that of providing *E* with data on the changes in *S*'s perception of the objects *themselves* as they begin to serve as cues.

A list of the cue-demonstrations utilized in the experiment and the frequency with which they were introduced during each hour for one of the *S*'s is presented in Table 1.[3] Since each cue-demonstration exists as an integral part of the results derived from them, a complete description of each cue-demonstration and how the cues were introduced is presented in the section on Results. An attempt was made to present the objects in the room in a sequence of perceptual potency. In other words, the first objects or cues presented to *S* are predominantly *perceptual* in nature and contain a minimum of *intellectual knowledge* or "give away" information. For example, the cigarette package demonstration is presented first and most frequently, since it is very difficult to "intellectualize" this cue and since it is a potent cue perceptually. In contrast, the back wall movement and binocular vision demonstrations are presented later and less frequently.

C. Criteria for Perceptual Change

1. Phenomenological description of the total structure of the room. A description of how the room looked and of the intervening emotional and thought processes of *S* was obtained through the minute-by-minute reporting of the *S*'s experiences. Only after *S* has had opportunity to express spontaneously his style of perceiving, attending, thinking, and feeling about the experiment would *E* attempt to have *S* elaborate on various components that may have been omitted. Even though omission and the nature of omission is significant in itself, it is important to attempt to gain some insight into the facets of behavior that are not easily expressed by *S*. Thus, after such initial questions as, "How does it look?" or "What do you see?" and also after a certain amount of emotional support is given *S*, as the experiment progresses, *E* may ask such questions as: "How do the window frames look? What is their shape and size? How did you go about looking at the windows; the cigarette packages? What are you looking at now? What were you looking at when the cigarette packages were moving? What were you trying to do in pointing the stick at the windows? What were you thinking about when you said that the cigarette packages were shrinking in size? How did you feel when you said that the room looked like it was changing in shape?" etc. The *E* attempts not to give *S* any "leads," but rather to focus attention on various aspects of the situation that may have been omitted.

The *S* is not given much direction as to *what* he should see, or *where* he should look, or as to *how* or in *what language* he should describe it. To obtain the full richness of perception and its development in its most natural manifestation, it was considered expedient to examine the processes of development in *S's* own medium, his own way of operating, and at his own speed.

2. Phenomenological description of objects in the room. A full description of how the cue-demonstrations or objects looked to *S* was obtained as described above.

D. Transfer Experiment

To test the generality of perceptual development, a differently-shaped distorted room is utilized. This transfer

[3] The binocular vision demonstration was eliminated for *S*-3. However, essentially similar results were obtained.

TABLE 1

FREQUENCY AND TIMING OF CUE-DEMONSTRATIONS (*S*-2)

Session Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Totals
Length of Session (Hours:Minutes)	1:00	1:40	1:15	0:30	1:30	1:15	0:40	1:05	1:00	1:15	0:40	1:00	1:15	1:10	1:05	1:15	1:00	1:15	0:50	1:40	2:35	24:55
Cumulative Time	0:00	1:00	2:40	3:55	4:25	5:55	7:10	7:50	8:55	9:55	11:10	11:50	12:50	14:10	15:20	16:25	17:40	18:40	19:55	20:45	22:25	24:55
Cue-demonstration:																						
Back wall cigarette package	2	20	8	6	16	8	4	6		4	4	4	8		6	1		4	4	1		106
Designed cards			1	1	1	1	1	2				2						1	1			11
Moving yardstick					1			1			1			1	1	1		1				7
Stick pointing	1	1					1	1				3	1		1	4	2	1		1		17
Man and chair	1, 0*	1, 0	0, 1	0, 1	1, 3	1, 3	1, 1	0, 3	0, 3	0, 6	0, 2	0, 4	0, 5	0, 6	0, 5	2, 2	1, 0	1, 4	1, 3	1, 2	4, 1	15, 55
Rectangular card					1	1			3	1	1	1	3	3	2	1		1		1		10
Trapezoidal card						1				5		1	2	2	2			1	1	1	1	17
Back wall movement														1			4					5
Binocular vision		2																			1	3
Outside light					1			1			1		1	1	2	3		1	2	1	2	16
Fluorescent light		3			1	1		1			1	1	1		1	1		1	1	1		14
Light variation	2	3				1		1			1		1		1			1	1	1		13

* Presented in coordination with another demonstration.

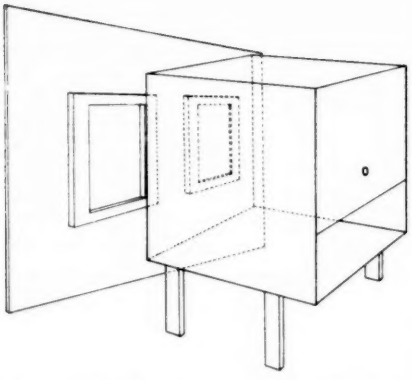

FIG. 5. The objective nature of the distorted room: perspective view, Room 2.

room (which will be referred to as Room 2, as contrasted to the training room, which will be referred to as Room 1) is an equivalent projection of the first distorted room, but distorted in exactly the opposite way. Whereas Room 1 is distorted to the right, Room 2 is distorted to the left, but in precisely the same manner (see Figs. 5 and 6). Since both rooms are projections of a square room, they should initially be perceived as square, such as indicated in Figs. 3 and 4. The rooms were pretested and their perceived squareness was empirically verified.

After many hours of presenting different objects in the room and then repeating the presentations, *S* finally perceives Room 1 and the objects in the room as they really are. Then, without *S*'s knowledge, Room 2 is put into place. The *S* enters the experiment just as if it were a continuation of the training with Room 1. He looks into Room 2, and just as with Room 1, begins the session with a complete phenomenological description of how the room looks to him. Similarly, objects (i.e., the cue-demonstrations) are presented just as they were presented in Room 1. Thus, the same procedures are utilized in Room 2 as in Room 1, but for a different purpose; i.e., to test the generality of learning. Accordingly, phenomenological data on the perceptual changes in the objects and the total structure of the room also are obtained throughout the transfer experiment.

E. Subjects

The data for the experiment were obtained from three female *S*s. All were nonprofessional employees (e.g., secretaries) at The Menninger Foundation. *S*-1 was tested only in Room 1, for 20 hours; *S*-2 in Room 1 and then several months later in Room 2, for a total of 35 hours; *S*-3 in Room 1 and immediately afterwards in Room 2, for a total of 60 hours.

IV. RESULTS

A. The Training Experiment

Because of space limitations, we shall present here the data from only one *S*,

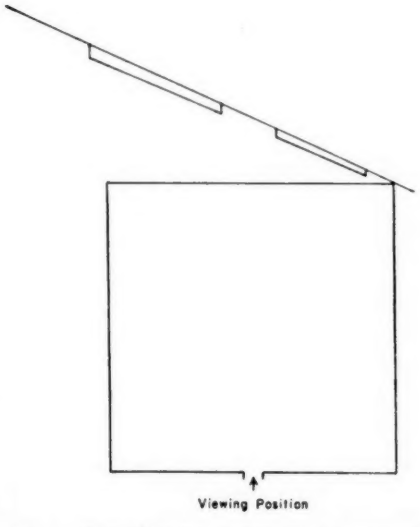

FIG. 6. The objective nature of the distorted room: plan view, Room 2.

namely, *S*-2. We shall later discuss the general trends of development indicated by the three *S*s used in the experiment. After each excerpt or group of excerpts from a protocol, we shall describe in psychological terms the meaning of the raw data. An indication of the number of hours experience up to, but not including the time of the training session being discussed, precedes each excerpt. For example, 2:10 represents two hours and ten minutes of previous experience.[4]

1. Total structure of the room.

0:00 (*S* looks into the room for the first time. There are no objects in the room. The *E* says to *S*, "Open your eyes and look into the room. What do you see? Just tell me how the room looks.") The room looks like a regular room. It's rectangular. The windows just look rectangular.

1:00 (At the beginning of the next hour *S* looks again into the bare room.) I still have a feeling it's square. It looks square. The windows look about the same. They are rectangular.

These initial remarks demonstrate the effectiveness of the experimental room in reproducing the proximal stimulus distribution of a square room; i.e., it is perceived as a square room with rectangular windows of equal size.

1:00 (The *S* has just previously viewed the cigarette package moving into the distance along the back wall.) I wish the windows weren't there. Those darn windows. You get the feeling you're looking at something that doesn't make sense. They are perfectly straight.

It is noted that the perception of the windows as rectangular and in the frontal plane provides a strong stimulus configuration that sets up a strain in the perceptual system, since it conflicts with the perception of distance induced by the perceived movement of the cigarette package into the distance.

1:00 (The *S* views the room with one eye, but had just previously viewed the room with binocular vision.) It's a square room. The illusion is back. I can remember how the distortion is, but I can't see it that way. Up at the ceiling, though, I can really see it going up at an angle. But at the tops of the windows, I know how it is, but it doesn't look that way. The string (on which the cigarette package moves in the cigarette package demonstration) seems to be going down a little and just a little on the bottoms of the windows. I can see the gap; the corners do not meet up any more. I can feel the space in there. (The *S* views the room binocularly again, and then back to monocular vision.) That space seems to close up. The depth, I don't see it. It doesn't look like a real corner, but I can't see the depth. . . . It doesn't look distorted.

Even though *S* had just previously perceived the room as it objectively was with binocular vision, there was no complete carryover to monocular vision. This indicates that an intellectual awareness alone brought about by seeing the room in its objective shape with the aid of binocular cues does not directly alter the mode of perception with monocular cues. However, the beginnings of changes in perception in the direction of veridicality can be noted. At first, there is perception of some space, and concomitantly, the string and the bottoms of the window frames appear slanted.

2:40 (The *S* views the bare room at the beginning of the third session.) It's about the same as yesterday. It still looks square, but not as square as it did. I have no feeling of solidity about the back wall. It is not part of the room as it was in the beginning. It looks even less solid now than it did in the beginning today. I sort of get the feeling that there is an angle to the wall, but I don't see the trapezoidal shape of the windows. The left window looks perfectly rectangular, but the right window does not look perfectly rectangular. The right window looks a little larger.

One of the first feelings that *S* manifests in the early stages in the development of the perception of depth relates

[4] Individual demonstrations were not timed, therefore the indication of time intervals is discrete and only covers the time *up* to but not including the separate parts of each individual session.

to its lack of definiteness and solidity. However, the feeling of definiteness increases with further experience. With the early perception of the angle of orientation, even though this may be derived from a diffuse feeling of depth, one finds the beginning of changes in the perception of size. This demonstrates the relationship between perceived size, shape, and distance.

2:40 (The *S* has just viewed the cigarette packages moving to the left [L] and right [R].) When I look at the room as a whole, I can look at the different parts of it and see distortion, but I can't look at the whole. For instance, the ceiling, I see a definite angle, a real slant. When I look at the ceiling, then I can see an angle, and I can follow the line of the windows with the ceiling, and then they look as if they are slanted parallel with the ceiling, slanted toward the upper right. The lower right corner throws the thing back into a room. I can't see the space in there, even though it is not a real and solid corner.

There is an indication that an undifferentiated "whole-perception" plays a part in impeding progress in perceptual change. When *S* is able to differentiate the whole into its parts, there is a development toward perceiving the distortion. It is the relating of the parts to the whole which helps to bring about changes in the perception of the window frames.

4:25 (The lower cigarette package is moved from the left part to the right part of the back wall without giving *S* notice that the package is going to be moved.) The wall just seemed to move back when I wasn't expecting the cigarette package to move, but it didn't do it when I was expecting it. (Pause) I just got the overall feelings that I had been shoved back a couple of paces. I got the feeling suddenly that there was more distance between the wall and me. It just seemed to open up. It was a contrast between the way I had been looking and the way it suddenly became.

The perception of distance brought about by the perceived movement of the cigarette package into the distance resulted in the wall's being perceived farther away from *S*'s stationary body. Then after awhile with no change in the stimulus field, *S*'s body was perceived farther away from a stationary wall. This indicates the potency of the framework in resisting change and maintaining as stable a configuration as possible at the expense of the illusory experience of body movement. When there is a stress in the perceptual system, something has to give. In the present case after the increased distance was attributed to movement of the back wall, the framework resisted the change, and part of the distance was attributed to movement of the body.

These results may be compared with those of Witkin, where *S* was seated in an upright, stationary chair while enclosed in a small room which was tilted left and right. Under these conditions the movement of the room with chair stationary induced an illusory experience of body movement. Witkin states:

> As the relation between body and field changed, owing to movement of the room, either some or all of the change was attributed to movement of the body. When *all* the change was attributed to body movement, the room was perceived as completely stationary, even when it had been moved through an arc of 70°. The direction of the illusory body movement was, of course, opposite to the objective movement of the room. When the change was attributed only *partially* to the body, the *S* did perceive movement in the room, but assigned some of the change to movement of his own body. At such times, the room was perceived as moving in one direction—the one it was actually taking—and the body in the opposite direction. Since part of the objective movement was "taken up" by the body, the perceived speed of room movement was less than its actual rate (21).

In the distorted room the perceived distance induced by the movement of the cigarette package remained invariant, whether the increased distance was "made up" by or attributed to the wall's being perceived as farther away from the

stationary body, or to *S*'s body being perceived as farther away from the stationary wall. (Cf. also Duncker's experiments in induced motion (5), Koffka (12) for a further general discussion on the role of the framework in perception, and Hilgard (9) as to the significance of the framework in relation to the initial perceptions in a distorted room.)

5:55 (The designed cards are placed on the upper and lower edges of the window frames.) It looks different. It doesn't look like a room. The difference is the space I see in the corner. It doesn't look like a corner. The cigarette package looks so much in the foreground. It looks near and the other one looks farther away. It is nearer. The wall is no longer a part of the room, and I could see it the minute I looked in. The three cards give the lower window a slant. The left window looks rectangular, the right window looks a little wider and it looks as if it slants just a little. Every other time when I first looked in, it was a room, but this time there is a square part, and a back drop.

The perception of more space is developed with the support of the presented size-distance cues (i.e., the cards and the cigarette packages), with a consequent increase in the perception of slant and definiteness to the back wall.

5:55 (The two cigarette packages are placed in a stationary position on the right side of the room; the lower one on the back wall at B; the upper one at the right side of the cubical section at B'.) One (package) is closer than it ever was. The close one, and the other one is farther away. I don't think the room is straight at all. The right side looks shorter. . . . The room looks different, because the front end, the side is pulled in. The room is crooked. It's pulled away from the back wall. I can see the space in there. The back wall looks slanted a little, but it's the rest of the room that makes up for the space.

7:10 (The *S* views the bare room at the beginning of the seventh session.) Both the back wall and the room are at an angle. The room is pulled back a little on the right and the wall is a little farther away on the right.

Again, when a strain is placed on the perceptual system (the greater perception of depth), it is not the back wall that completely offsets the stress. This time part of the cubical section itself (the right side wall) is perceived as shorter to "make up for the space." Part of the perception of increased space is attributed to an increased angle of orientation of the back wall and part is attributed to a shrinking of the right side wall. It appears that the perceived squareness of the back wall with its rectangular window frames is a very stable configuration that strongly resists changes.

7:50 (A fluorescent light outside the room is turned on and shadows are thrown onto the back wall.) The windows don't look alike any more. The one on the right looks bigger and definitely slants away from me. I can see the window going away from me on a slant. Before, the windows seemed straight across and the wall, too. Before, I really didn't see space. I just knew it wasn't joined. But I could see the space between the cigarette packages, in certain places. The left window still looks rectangular. The right side wall still looks shorter.

The shadows on the back wall provide cues for the distance and angle of orientation of the back wall. Then the perception of the orientation of the back wall influences the perceived size of the windows.

7:50 The *S* commented that when she would attempt to "hold on to" the trapezoidal shape of the window, she would feel a muscle strain in her eyes, as if she were crossing her eyes. She also mentioned some feeling of slight dizziness and uneasiness. The *S* reported that she missed a day of testing because her eyestrain was quite noticeable; it lasted even after the experimental session. She said that she would not cross her eyes, even if it were for the experiment. It was easier, she reported, not to see the trapezoidal shape of the windows, because then she would not feel this discomfort and tension. She also stated that the right side of the back wall was difficult to get in focus, especially after focusing on the left window, and that it would blur. There seemed to be some kind of "block" in her attempting to focus, as if there were something hindering her focusing on the right side of the back wall: "The right side of the right window frame becomes indistinct, right where I would see the difference (in trapezoidalness)." It was at these times that the eyestrain seemed

to have developed. During an interview *S* related that she would often cross her eyes during childhood as a prank. Someone told her that her eyes might remain crossed, and that she would have to have an eye operation and her eyes would have to be put back into place surgically. The *S* expressed a desire to discontinue the experiment if the eyestrain should continue in further sessions. The *S* was given an opportunity to explore her feelings on various subjects; e.g., her childhood learning experiences, her being a subject, the experiment, the relation of the experiment to psychotherapy, her feeling free during the experiment to say what she wanted. In the following session, *S* reported that the eyestrain was gradually decreasing and finally disappeared, and the experiment continued without any further strain reported.

These comments give us some clues as to the motivational dynamics in perceptual development. It seems that learning even in a "cold" laboratory setting is intimately related to the personal life of *S*. There was resistance to learning or changing, especially when it evoked negative experiences associated with childhood. This was manifested through the appearance of anxiety and tension and was acted out through resistance to the experiments. Since it involved less anxiety, it was easier not to learn or change. If progress were to take place, the resistance had to be resolved and motivation to perceive reality had to overcome the motivation not to learn. When the resistance was worked through or resolved, the learning process was continued and progress was resumed.

Part of the perceptual basis for the eyestrain may be attributed to the conflict between cues, i.e., between visual accommodation that would be adequate for a square room and accommodation for a distorted room. In other words, *S* accommodates for equal distance between left and right sides of the back wall, while veridical perception would necessitate accommodating a greater distance to the right side of the back wall.

8:55 (The cards are placed only on the tops of the window frames.) When I first opened my eyes, it looked farther away than I expected it to be. Then it sort of came closer, but it still seemed to be slanted quite a bit. The tops of the windows look slanted with the cards, rather than the cards look slanted with the tops of the window. The bottoms look pretty straight. The windows no longer look the same size to me. The right one looks larger. Just slightly, the left one looks trapezoidal, when I look at the whole thing. It's only when I look at the tops alone that I can see the slant more.

The influence of the parts (the cards) on the perceived structure of the framework (the window frames) is noted; i.e., the cards are perceived as slanted, and the top part of the window frames where the cards are placed is influenced by this slant. It is when *S* perceives the tops of the window frames independently of the total structure of the room, that vertical perception is facilitated. Since the cards were not presented on the bottoms of the window frames, there was no cue support there and the window frames were perceived as straight on the bottoms.

14:10 (The *S* views the bare room at the beginning of Session 14.) I had to look at it for awhile. But after I looked at it for awhile, the left window looked trapezoidal and the right window frame just a little. I always think I'm going to see it the way I think it is, but when I look in, it isn't.

15:20 (The *S* views the bare room at the beginning of session 15.) Hmm, it didn't look quite so square. . . . The left window looks quite a lot like a trapezoid. The right window doesn't really look rectangular, but I have to look at it to feel it as a trapezoid. After I look at it for awhile, it looks trapezoidal.

Developmental processes appear to take place not only over long periods of time, but even within a single viewing period. For example, after *S* concentrates her efforts on the window frames for awhile, they take on the trapezoidal shape.

15:20 (In the previous demonstration a large trapezoidal-shaped card was placed in front of both windows in frontal and slanted orienta-

tions.) When I look all around, and at the other window, the right window looks more trapezoidal. But it doesn't look like it would if it weren't slanted away from me. But I can't think of it as a rectangle, because I can see the slant.

At this level of development the role of the comparison of parts in facilitating the development of veridical perception is indicated.

16:25 (The *S* views the bare room at the beginning of Session 16.) I can really see a slant, and see a difference in the windows—the right one is larger, faintly trapezoidal—without any particular effort on my part. The left one looks trapezoidal in about the same degree as the right one.

18:40 (The *S* views the bare room at the beginning of Session 18.) It doesn't look flat. The wall looks slanted. I can't quite decide how the windows do look. I feel a little lost without the cards on the top. It was easy for them to outline the shape of the windows. I can see the trapezoidal shape a little, but it requires more effort without the cards. The bottoms were easy to see the trapezoidal shape because the cards outline the window frame (on the bottom).

19:55 (The *S* views the bare room at the beginning of Session 19.) Something's missing. It's kind of bare without the upper cards. It looks kind of close. The windows look kind of trapezoidal. (Pause.) It doesn't look so close now. The right window looks larger. It looks different now than when I first looked at the room. The window looks more trapezoidal and I can see more space on the right side.

At this state of development the percept is not fully stabilized; without the support of the size and shape cues afforded by the cards, there is at first a regression in the perceptual outcome. However, when more effort is expended, an advanced level of achievement is attained.

20:45 (The *E* sits on a chair which is placed in the space and *S* is instructed to point the stick at various parts of the back wall.) I can make a pretty good guess (of pointing the stick at the back wall), but I'm not really confident. The chair with you in it gives it more reality.

The effect of the perceptual system on the motor system is noted here. The *S* has made much progress in perceiving the distance and the angle of orientation of the distorted back wall. This is reflected in "good guesses" in judging the distance with the stick. The potent overlay cues provided by the chair in the space help to provide a sense of reality to the space. (Cf. Michotte's work on the phenomenology of reality [13].)

22:25 (Monocular viewing after viewing the room binocularly.) I don't see much difference, but it seems there's less space. The windows look the same. It isn't quite as clear and sharp as with two eyes, but I didn't have any sense of changing.

There is not much difference in the perceptual achievement of monocular and binocular vision at advanced levels of development. Trapezoidalness of the window frames is the same. However, there is less perceived space and the distance is less well-defined.

22:25 (The *S* was asked whether she could possibly see the bare room as she had previously, i.e., square with rectangular window frames.) It doesn't look like a (square) room. I'd have to stop and think about it in order to see it as a room. I'd have to wipe out the way I've been seeing it all along. I can't quite close up that space over there. It doesn't come. Now I can't see them as rectangles. There is something in between that keeps me from seeing them as rectangles both at the same time. I can see part of it as a rectangle, but one corner bulges out somewhere. When I look from one window to another, they look like trapezoids. If I look in one spot, I can see one of them as rectangular, but when I move, then immediately the trapezoidal lines jump up. If I look in, I maybe can see both windows as the same size, but when I look back and forth, I lose it. They are different in size. I can't completely shut it out. The trapezoidal shapes keep jumping out, the corners and the sides are trapezoidal. . . . In this situation I felt free to learn it the way I preferred, and not forced to learn it in any particular way. I felt kind of confident that I could learn it in any way I choose. In other situations, I feel forced—that I have to learn things when I didn't want to or like it particularly. (Pause.) I can almost see it as a corner, but I can't accept it. I can't talk myself into my seeing it as a corner. When I look at the rest of the back wall, then it definitely doesn't look like a corner. When I look at the back wall and the whole thing, I get more sense of space than when I just look down at the corner. It just falls in, the slant and shape and

size of the windows and everything. It doesn't look like a room. (Laughing.) I'm not going to have to learn to see this as a room again, am I?

At advanced levels of development the percept becomes stabilized and takes on the appearance of the objectively-shaped distorted room. It is noted that it is an active comparing of different parts of the room (e.g., the window frames) and relating the parts to the back wall and the room as a whole that helps to bring about veridical perception. The different parts of the room become integrated among themselves and with the whole room. "It just falls in, the slant and shape and size of the windows and everything." That lack of integration or isolation of parts hinders veridical perception is indicated when *S* reports that she can see a part of the window frame as rectangular when she concentrates *only* on that part. Also noteworthy is *how S* went about learning a new mode of perceiving. She reported that she felt free to learn it the way she preferred. By providing a free and accepting atmosphere for *S* during the experiment, there appears to be less possibility that we have unwittingly imposed on the data any preconceived notions of how perceptual development should manifest itself.

2. *Cue-demonstrations. a. Cigarette package demonstration.* In this demonstration a cigarette package is strung along the back wall from the point A to point B (see Figs. 3 and 4). The cable is moved by a reversible direction motor at the rate of 7 inches per second. Another cigarette package may be moved across the cubical section from point A′ to B′ in the frontal plane at the same speed as the other cigarette package. Each package may be moved at the same time as the other package or independently of it. The package that runs along the back wall is placed on a string positioned below the string that runs across the cubical section. Therefore, the back wall package is referred to as the lower package, while the cubical section package is referred to as the upper package.

0:00 (The back wall [lower] package is moved from the right side to the left side of the back wall [B to A].) The cigarette just grows and goes straight across the room. (The lower package is moved from the left side to the right side of the back wall [A to B].) Now it's shrinking, the cigarette package, it's shrinking.

The cigarette package is perceived as moving from A′ to B′ and B′ to A′, while objectively it is moving from A to B and B to A. The package is perceived as moving in the frontal plane along the back wall of a square room, and consequently is perceived as being at an equal distance from *S* on the left and right sides of the room. Size constancy breaks down and size is perceived as varying with retinal angle. The changing retinal image of the package is attributed to a change in objective size, and not to a change in distance.

1:00 (Before the present demonstration had taken place *S* had viewed a man walking into the room into the space—see man and chair demonstration; had practiced pointing a stick at the back wall—see stick-pointing demonstration; illumination had been varied up and down and thus varied the brightness of the back wall—see light variation demonstration; and had practiced viewing the cigarette package moving to the right [R], to the left [L], and again R and L. Just preceding this report the upper and lower packages were again moved R and L across the cubical section and back wall respectively. Thus, the reported percepts represent an end-result of intervening experiences in the room.) The top one looks larger. That's because it's closer. The other one went down along the back wall. If the windows weren't there, I could see the cigarette package going down and back, because when I keep my eye just on the lower cigarette package, I can see the cigarette package going down and back; then if I look up at the windows, that feeling is gone. Then, it's just a cigarette package that's just changing in size.

When *S* perceives the cigarette package independently of the framework of the

room, she sees it as moving back into the distance and at an angle, as it objectively does. But when *S* looks at the window frames and comes under the influence of the framework of the room, *S* perceives the distance to the left and right sides of the back wall as equal. The varying distance is not taken into account, so that perceived size varies with retinal angle.

1:00 (The lower package is moved R and L.) I can see it as going up and down. If I look at it and not think, it looks like it goes straight across and gets smaller. Then it goes down and back, but stays the same size.

If *S* maintains a passive, naive attitude, the perception of size variation of the package is the outcome. However, more active participation brings about the perception of distance and size constancy. The achievement of constancy, however, is not stable at this level of development, as the following excerpts indicate.

2:40 (The lower package is moved R, L, R, L, R, L along the back wall, while the upper package is placed on the right side of the cubical section at B.) When they are both in the right corner, I have a real feeling that there is space in the gap. Then I can bat an eye and everything is changed, changed back into a room. When I keep my eye on the lower cigarette package it seems like the wall changes and becomes out of line and the cigarette package is going away and down. But then when I take my eyes off the cigarette package, there is some magic trick going on and it becomes larger or smaller.

3:55 (Both packages are in a stationary position on the right side.) At first glance I saw a big cigarette package and a little cigarette package, and I didn't think of one as being farther away than the other. Just looked like one was bigger than the other. Now it seems that one is farther away than the other.

The *S* gradually develops a percept in which changes in perspective or retinal size are attributed to changes in distance. In other words, increases in perspective size are not attributed to increases in the size of the package itself, but to the increasing nearness of the package. Perspective size of the object serves as a cue to distance. When this occurs, the perception of the package influences the perception of the back wall. The *S* perceives distance and space between the cubical section and the back wall and the back wall is perceived "out of line." However, the perceptual achievement at this level of development is unstable; the room again changes into a square room and size invariancy of the package is lost. The room has a strong tendency to maintain its squareness and consequently distorts the objects in the room. Perceiving the package independently of the back wall and yet taking it into account by relating it to the back wall facilitates the development of veridical perception of both the package and the back wall.

3:55 (The lower package is moved to the right along the back wall and is not stopped at B, but goes out to the right beyond *S*'s view. In a similar manner the package is moved into view to the L from a position beyond B. This sequence is repeated R and L.) When you move it beyond the corner, it takes away the corner. It goes on with the back wall and beyond the right wall.

When the package is moved beyond point B where it disappears from view, it serves as an overlay cue; i.e., when the package cuts through the perceived corner of the room, it decreases the potency of the apparent solidity of the corner.

4:25 (The upper and lower packages are moved L and R.) The cigarette package does not change in size when I watch it move. It goes away, but it doesn't get smaller; it stays the same. But when it stands still, it looks like a smaller package, even though it doesn't look like it is directly below the upper package. When you move it, then it is different.

The role of movement of the package in increasing its potency as a cue to distance and in helping the package to maintain its perceived constancy is demonstrated.

7:50 (The lower and upper packages are moved L and R.) It makes space.

12:50 (The package is moved L, R, L, R.) When

I kind of look at the back wall, I can tell the downhill movement better than when I look at the cigarette package directly. I sort of look at the back wall without really seeing it. When I look at the package, I can tell that it is going farther away better than I can tell it is going downhill.

At this level of development perceiving the package in relation to other parts of the back wall emphasizes the perceived slant of the package. Formerly, the package could not be adequately related to the framework because the package itself was influenced by the framework in the sense of losing its individuality. Presently, however, the package having been adequately differentiated from its surroundings, it can be related to the framework without being enveloped by it.

19:55 (Upper and lower packages are moved L, R, L, R.) It looks a little more slanted than the bottom of the window. Actually the cigarette package looks parallel to the bottoms of the windows, but when the package moved it seemed more slanted than the window. It looks as if the angle between the windows and the string widens a little as it goes out. When I look at the lines alone without looking at the windows or the back wall or the cigarette packages on the string, it looks like parallel lines. The cigarette packages do something for the lines. The lower one is so much farther away. The difference in the cigarette packages has something to do with shoving the wall out.

After approximately 20 hours the slant of the package is perceived as it is objectively; i.e., more slanted than the window frames. The influence of the package on the perception of the slant of the string and on the angle of the back wall is noted. Both the movement of the package and its relating to and comparison with parts of the back wall help in facilitating veridical perception.

In connection with the cigarette package demonstration we should describe a rather striking effect that was obtained with *S*-2 during the post-training "satiation" series. (See Section IV, B, 1.) Five months after *S* had learned to perceive the room as it objectively was, *S* was asked to come back for further testing. When *S* looked into the room after five months a noticeable regression in the newly-developed percepts was manifested. Therefore, further training was undertaken in which the cigarette package demonstration was again utilized, this time in coordination with a new cue-demonstration—the projecting strips demonstration. The projecting strips demonstration consists of taping four strips of poster board, one inch wide and three feet long, on the ceiling, floor, and right side of the cubical section, respectively, in such a way that they project out from the cubical section until they touch the distorted back wall. This provides a potent distance cue for *S* and has the effect of "pushing the wall back into the distance." With the cue-support provided by the strips, *S* perceived the back wall at its objective angle of orientation and the moving cigarette package as maintaining a constant size. With the lower cigarette package remaining stationary on the right side of the back wall, ***E*** quickly removed the strips from all parts of the room. The following is a verbatim report of what occurred.

E: How does it look as I take the strips off?
S: Umm, it seems a little closer in a way. The difference is in the cigarette packages. The back cigarette package became smaller. The wall got closer.
E: The back cigarette package became smaller. In what way?
S: It shrank.
E: It shrank.
S: Um-hmm. That doesn't make sense. It means just that the cigarette package shrank. cigarette package logically should have looked larger, shouldn't it? But it shrank—I mean it Because actually if the wall came closer, the became smaller to my eyes, so that means it shrank.
E: Well, just describe what it really looked like. I don't mean that it must make sense. Just describe what you saw.

S: Well, the wall came closer, the space narrower, and the cigarette package became smaller—it became smaller as I looked at it. There was a movement that caught my eye, even though I wasn't even looking at the cigarette package. That movement really came so it looked smaller.

E: You saw the cigarette package grow smaller as the wall came nearer.

S: Yeah, but it was really a movement—you know, such as a movement catches your eye.

E: Were you looking at the wall over here?

S: I wasn't looking at anything particularly. I was just watching you peel those things off. And there it was, really a movement which attracted my attention. Just like I was looking at nothing and I saw something move, so I wasn't watching those things, my attention was attracted to them.

This is a unique form of phi phenomenon; i.e., a perceived movement in the third dimension with no change in the stimulus object. When the distance cues were suddenly taken away (i.e., when the strips were removed), the back wall was perceived as nearer and the cigarette package as smaller. Since size constancy depended on perceiving the object-at-a-given-distance, when the perceived distance changed (i.e., shrank), there had to be a concomitant change in perceived size (i.e., the package also had to shrink). Just as previously there was a developmental progression from retinal size to objective size through the development of distance perception, so in reverse there was a breakdown in size constancy with a consequent regression toward retinal size when distance cues were reduced. These results again indicate that an object is perceived in terms of its localization in the spatial context; when the perception of the spatial framework changes, so also does the perception of the object change.

b. Designed cards demonstration. In this demonstration, 2¼ in. by 3½ in. white cards with black designs printed on them are used. Cards with a square are placed on the top edges of the back wall window frames so that the cards lean against the top edges and back wall for support, or are taped onto the lower parts of the window frames; six on the left window frame and ten on the right window frame. In another part of the demonstration cards with plus designs are taped to the sides of the window frames; seven on the left side of the left window frame and nine on the right side of the right window frame.

At first the cards introduced into the room are perceived as distorted. The whole influences the parts. The cards are perceived as "crooked" or diamond-shaped to fit in with the perceived rectangularity of the window frames. However, when more cards are introduced and placed along the tops of the window frames, they are perceived as receding and on a slant. The parts then influence the whole; "It makes the windows go up on a slant" and the "right-hand window frame looks much bigger now because I can see more cards up there. I saw you put the cards up there and I compared them with you, so I know they are all the same size cards. . . . It didn't seem like crooked cards any more." The comparison of the perspective size and shape of the cards with the size and shape of *E*'s hand helps to bring about a change in the perception of the cards. It is the relating of the cards to something of known dimensions that facilitates the development of constancy of the cards. Since the cards were not placed on the bottoms of the window frames, there was no perception of slant on the bottoms. In the early stages of development the perception of objects in the room has an influence only in the area immediately surrounding them.

With further experience the perspective size of the cards serves as a cue to distance; i.e., the perspective smallness

of the cards on the right side is attributed to the receding and orientation of the cards and not attributed to the smallness of the cards. They have, therefore, a constant size-at-a-given-distance. At this level of development, there is not yet a stabilized relationship of perspective shape with perceived slant and at times the cards are perceived as if placed horizontally. However, as the perception of the slant of the cards increases, it influences the shape of the window frames. At advanced stages of development, the perception of the windows develops increasing stability and gains freedom from the cue-support provided by the cards. The *S* states, "I can see the windows as trapezoidal plainly."

c. Yardstick demonstration. In this demonstration a yardstick with large black numerals is held vertically in *E*'s hand and is moved from B to A and A to B at the level of the window frames. The yardstick is held approximately one-quarter inch from the back wall as it is moved along. In another part of the demonstration the yardstick is moved in a similar manner along the back wall, but held in a horizontal position in front of the center of the window frames.

4:25 (The *E* moves the vertical ruler to the left [L], to the right [R] and then L and R again.) When I concentrate on the ruler, it first changed in size. It looked larger and smaller, and then as I looked at the ruler, it stayed the same size, and the background changed. It just sort of receded, and I saw the ruler move forward and backward. When I concentrate on the background, the left window grows smaller, and the right window was larger. It was strikingly noticeable, because of the size of the ruler in relation to the size of the window.

Initially, the perception of the size of the ruler is distorted and changes in size as it is moved along the back wall. Then, as *S* takes account of the distance, the ruler remains the same size and parts of the back wall change (e.g., the size of the window frames change). It is when *S* perceives the ruler in relation to the framework that changes are perceived in the framework itself.

7:50 (The ruler is moved L and R.) They looked trapezoidal while the ruler was passing. (The ruler is momentarily taken out of the room.) Now they don't look trapezoidal any more. When you hold the ruler still, I have to compare the length of the ruler with the length of the other side of the window. And then it looks trapezoidal. But then it sort of fades away when I look at the whole thing. When you move it along, I can compare it as it moves so it is easier to compare.

When *S* compares the object with the background and thus relates the object to the background, size constancy of the ruler is obtained, and the windows change in size; i.e., they also achieve veridicality. However, without the support of the size-distance cue from the yardstick, the window changes back into a rectangular shape.

14:10 (The ruler is moved L and R.) Nothing happened to the ruler when it came in, but it got smaller when it went out. (The ruler is moved L and R again.) Now, nothing happened to the ruler but the window widened. The ruler stayed the same size. I was looking at the ruler, but I didn't shut out the background. I was just looking. I was following the ruler with my eyes, but I was also sort of, I wanted to see everything else, too, so I wasn't looking just at the ruler. I wasn't concentrating on anything, but I was looking at the ruler. I was sort of looking with my eyes and waiting to see what happened. I used to concentrate very hard on one object or on one little portion. I used to shut out everything except this one portion, but I didn't really see the rest of the room at all, wouldn't see anything except this one little thing. And now I can see so many more things and don't do that. I just look in and let everything register, and sort of take the whole thing in. If I looked at the whole thing then (before), I didn't learn as much. I have to feel the relationship of the one little object, fit it in with the room, and see the whole thing. It's just looking in, but not really looking at either one of them. I can see the difference in shape. It's just gazing, sort of.

The *S* expresses the kind of perceptual functioning that leads to a given per-

ceptual achievement. At a primitive level of perceptual functioning objects are not adequately related to the background, because the background is perceived in a global way. "(7:50) But then it (the trapezoidalness of the windows) sort of fades away when I look at the *whole thing*. (14:10) If I looked at the *whole* then (before), I didn't learn as much." In the early stages of development the object is embedded in the background and is influenced by it. Objects are distorted under the influence of the background. For example, the yardstick changes in size as it moves toward and away from *S*. However, taking into account a total differentiated field, both the space and the distance, leads to veridical perception of both objects and the back wall. In other words, higher levels of perceptual functioning allow for the object to be differentiated from the background and to be perceived independently of the surrounding framework, independently enough so that is can be *related* to the background. Thus, it is an independence without isolation. When there is a focusing to the exclusion of other objects, and when the object is viewed from a narrow perspective, the object is isolated from the background. For example, when *S* concentrates on the ruler to the exclusion of other objects and the background, size constancy of the objects and veridical perception of the background is not achieved. When this occurs, the total field is not taken into account; i.e., the distance and surroundings of the objects are not related to the object. In contrast, at advanced levels of functioning there is a relationship of reciprocality; the perception of the objective distance and shape of the back wall is taken into account and influences the development of constancy of the object, and coordinately, the object develops constancy and thereby influences the distance and shape of the back wall. (Cf. Schlesinger's conceptions [17] concerning focusing vs. nonfocusing ability in terms of cognitive-personality functioning.)

15:20 (The ruler is moved L and R.) The window widened and lengthened.

16:25 (The ruler is moved L and R.) The right window grew larger, the left window smaller, but there wasn't much difference in the change, as before. I'm seeing them better. Before, the right window really widened out, but I was seeing it pretty good now.

With increasing development of the perceived trapezoidalness of the window frames, the window frames become stabilized, and the influence of the ruler on the window frames becomes less.

18:40 (The ruler is moved L and R.) The ruler stays about the same size. The left window is quite a lot smaller. When it went out, it got a little smaller. The second time I compared it with the ruler, and the windows got larger and flared out. I took them both in together. There was a comparison. The first time I just looked at the ruler.

The role of simultaneous comparison of object to background in facilitating veridical perception is noted.

d. Stick-pointing demonstration. In this demonstration a seven-foot bamboo pole is given to *S* with the instruction to touch various parts of the back wall with the end of the pole. For example, "Touch the upper left corner of the back wall and then swing the stick over to the right and touch the upper right corner of the back wall, etc."

At first a lack of correspondence between the way the room looks to *S* and the way it really is leads to maladaptive motor behavior and lack of motor coordination by *S*. The *S* either overestimates or underestimates the distance of the various target points on the back wall. With practice, however, *S* improves in her motor performance and forms new

behavioral habits, but "the stick doesn't help me in seeing it." While the development of new percepts influences *S*'s motor performance, there is not much direct influence of the motor system on the perceptual system. Even though *S*'s motor behavior leads to an intellectual awareness of size and distance, her motor behavior alone does not lead to a perceptual resolution of contradictions. For example, by pointing to the four corners of the left and right windows in succession, *S* could kinesthetically feel a size difference and could thus become intellectually aware of the difference between the two windows. However, this awareness does not directly influence how the window frames look.

The effect of motor behavior with *S*-2 is that it appears to confirm or verify what *S* can actually see and also helps *S* to become more cognitively aware of what the nature of the distortion may be. It thus plays an important role in helping *S* to become more sensitive to new cues and increases the *S*'s "openness" to new perceptual information. In this manner new cues may more readily be integrated into the perceptual system and new percepts may more rapidly develop.

We should note that with *S*-1, her motor behavior appeared to influence her perceptions to a somewhat greater degree, although this influence appeared to be quite unstable. However, it is difficult to speak of the effects of motor behavior in isolation, since visual cues also are presented and made available to *S* when she performs motorically.

e. Man and chair demonstration. In this demonstration *E* walks into the space between D and D′ and walks next to the back wall from D to C and then from C to D (see Figs. 3 and 4). In another part of the demonstration a chair is placed in the space DD′C with the back of the chair closest to C. In still another part *E* sits in the chair when it is placed in the space.

The *S* initially perceives the back wall in the plane C′D′; i.e., the frontal plane. When a person is placed in the space DD′C, the back wall cannot be in the plane C′D′. The back wall then must be behind the object, localized somewhere in the space DD′C. This is what occurred with *S*-2. Thus, a person in the space provides a strong overlay cue; i.e., when one object is perceived in front of another object, or in this case in front of the background, the background must be farther away than the object itself. However, even though *S* becomes aware of more space, the space is at first diffuse and the exact localization of the back wall is not well-defined. Thus, when *E* initially walks from point D to C, and therefore closer to *S*, a changing retinal size is still perceived as a changing objective size, and not as a constant size with a changing distance. The awareness of distance is undifferentiated.

However, with increased experience with the overlay cues, the perception of greater distance to the back wall becomes better defined and this has an effect upon the perception of the windows; i.e., the windows are perceived as farther away with a consequent change in size. Without the support of the overlay cues (when the chair and *E* are removed from the space), the perception of distance is decreased and the wall is perceived as closer. As the perception of space becomes more differentiated it is perceived as more normal and it gradually develops more stability and definiteness. At advanced levels of development there is not a sudden shift in perception without cue-support. Also, the space is perceived as an empty space with boundaries and with particular functional dimensions; i.e., as

a space that can accommodate an object of a particular size.

Also noted during the development of the perception of the space is the conflict between cues. There is a conflict between accommodation for greater distance brought about by the overlay cues and accommodation for a lesser distance brought about by the initial localization of the back wall in the frontal plane. The nonresolution of the conflicting cues is manifested in the perceived blurring and fuzziness of the back wall and of the window frames.

f. Rectangular card demonstration. In this demonstration a large rectangular-shaped card made out of poster board is placed by *E* in various positions in the cubical section and along the back wall.

When *S* compares the card with the standard provided by the *E*'s hands, the card maintains its shape constancy; i.e., it is perceived as a rectangle at an angle. Also, when the card serves as a standard for comparison with the window frames, the window frames themselves begin to change toward their objectively trapezoidal shape. Without the comparison-standard of the card, however, the window frames change back to their previous rectangular shape.

However, a little while afterwards in the experiment, some kind of primitivation process seems to have been taking place. The rectangular card, when held in various positions and even in the frontal plane, is then perceived as trapezoidal. Only when the card is related to a stable standard (e.g., the vertical or horizontal surfaces of the cubical section), is veridical perception of the card obtained. It suggests that a regression in perceptual functioning had taken place, since previously the card had maintained enough stability to serve as a comparison-standard for the window frames. This form of instability of a percept and apparent reversal of a developmental trend is not uncommon in our protocols. It is usually an indication of a transitional stage between an old and a new form of perceptual functioning. In *S*'s attempt at a new form of functioning there is much groping and experimenting which gives the appearance of a regression, but which presages and prepares *S* for higher-level functioning. In the present case, it is noteworthy that the regression occurs during and immediately following the "storm" of the *S*'s development; namely, the period where *S* complains of tension, eyestrain, and blurring of the back wall (cf. the section on the total structure of the room). This appears to be a "high-water mark" or turning point after which the storm subsides and further development takes place at a rapid rate. This is the stage where earlier gains are consolidated to prepare the individual for further integration and development.

As the experiment progresses the card loses its constancy only when it is held close to the back wall. When the card is unstable and does not possess much potency as a standard, the card is distorted through the influence of the framework of the window frames. The framework of the window frames is more stable than the standard provided by the rectangular card. Therefore when the card is placed against the window frames, the window frames remain rectangular and the card itself is perceived as trapezoidal. The card is distorted to fit in with the perceived rectangularity of the window frames.

Different aspects of the framework are noted to have different degrees of potency. When the card is held flat against the window frames, the right window frame, being large and encompassing a

larger portion of the card, "swallows it up" and is a more potent framework than the smaller window frame. Consequently, the right window frame maintains greater resistance to change and coordinately more readily distorts the card which it surrounds. In addition, instead of the card's always being distorted to a trapezoidal shape, the *shape* of the card at times maintains its constancy, but at the expense of the perceived *angle of orientation* of the card; i.e., both the card and the window frame are perceived as rectangular, but the orientation of the card is distorted. When the card is held parallel to the window frame, *S* states, "The card looks like it is slanted into the window, like it is tilted away from me at a greater angle. That is why it looks like they are not parallel. I make up the difference in that it is tilted away more." However, when the card is held away from the window frame and is not in close spatial proximity to it, the window frame loses its influence on the perception of the card. Decreases in proximity help to release the card from the influence of the surrounding framework.

Gradually, the card is perceived more independently of the framework and therefore achieves more stability. The nearness or farness of the card from the framework becomes a less important determinant of the perceptual outcome and plays a less potent role in the figural effects. This is in contrast to early levels of development where proximity was a potent force in determining the degree of influence that the surrounding framework had on its enclosed objects.

At advanced levels of development the card develops more potency and becomes a more stable force in serving as a standard for comparison with the surrounding window frames. The card then maintains its constancy and is perceived as rectangular while the window frames change and are perceived as trapezoidal. When *S* relates the card to the window frames by simultaneously concentrating on and comparing the card with the window frame, veridicality of both card and window frame is obtained. Finally, when *S* perceives the card and window frames in a veridical and stable manner, there is less need for support from the comparison-standard in maintaining the perception of the trapezoidal windows.

g. Trapezoidal card demonstration. In this demonstration trapezoidal-shaped cards of different sizes, but of the same degree of trapezoidalness as the window frames, are placed in various positions inside the cubical section and along the back wall by *E*.

When the card is not perceived independently of the framework of the window frames ("when it becomes part of the window"), the card itself loses its trapezoidal shape and is distorted by the framework of the window frames. The card is then perceived as rectangular. But when the trapezoidal card is utilized as an anchoring point and is compared with the window frames, the window frames then are perceived as trapezoidal. At this level of development the perceived trapezoidalness of the window frames requires the cue-support of the standard provided by the trapezoidal card.

With the trapezoidal card there also is an indication of a primitivation of the percept, with the trapezoidal card being perceived as rectangular not only at an angle of orientation, but even in the frontal plane. Gradually, however, there is a development toward greater veridicality, with the card maintaining its trapezoidal shape in all positions. It is through comparison with other parts of the room ("I widen my range of vision so that the thing becomes small, so I can

get the shape of it in relation to you and the rest of the room") that veridical perception of both card and window frames is achieved.

At advanced levels of development, the window frames are perceived as the same degree of trapezoidalness as the card. However, size constancy is not complete; the card, as well as the window frames, are perceived as narrower when viewed at an angle of orientation.

h. Back wall movement demonstration. In this demonstration the back wall is moved in an arc with the pivot point at CC′ so that the angle of orientation of the wall is increased or decreased. Movement of the back wall permits *S* the opportunity to obtain different perspectives or views of the back wall.

Through the *S*'s taking into account and integrating the different perspectives of the back wall, the effect of movement of the wall is to facilitate perceptual change in the shape of the window frames. However, after the perception of the trapezoidalness of the window frames is stabilized, movement of the back wall does not influence changes in their shape; their shape remains constant and the distance changes.

i. Binocular vision demonstration. In this demonstration *S* removes the eye patch from her left eye and looks into the room with both eyes.

When *S* views the room with two eyes, she does not immediately perceive the veridical nature of the room or the objects. When *S* looks at the whole room, the configuration of the square room maintains its stability. Only when the total configuration is perceived in its parts does the perception of the distortion of the room and of the veridical nature of the objects develop. Thus, even with binocular vision a process of development takes place.

As the perception of the distortion of the room becomes stabilized, the utilization of part-perceptions in facilitating the development of a veridical percept is not required. At this stage of development the percept is well integrated.

At advanced levels of development there is a decrease in the difference of perceptual outcomes with binocular and monocular viewing. The *S*'s perception of the room monocularly is about the same as with binocular viewing. However, less straining and effort seem to be required to maintain a given level of achievement with binocular cues. In addition, binocular viewing, being a potent cue in the hierarchy of cues, appears to add the phenomenal feeling of "reality" to the perception of the distortion. Cf. Michotte (13) in his discussion of the phenomenology of reality.

j. Outside light demonstration. In this demonstration a light in a reflector is moved around outside the room in such a way that its beam is directed through the space on to the back wall. Because the beam of light is partially cut off by the ceiling, floor, and right side wall of the cubical section adjacent to the space, the light throws a combination of bright areas and shadows on the back wall.

Two cues for the distance and space are made available to *S;* first, shadows on the back wall provide cues for distance, and second, *S* perceives the light *in* the space, and therefore, the added light takes on "space-filling" qualities.

The influence of the light and shadow cues on the perceived structure of the window frames is at first negligible, since at early levels of development the space is perceived as indefinite and not well articulated. Even as the perceived orientation of the back wall develops, the rectangularity of the window frames presents a very stable configuration which

resists changes. As the space becomes better articulated, the windows very gradually change in size and shape. With the development of veridicality the perceived structure of the windows attains stability and requires less cue-support to maintain a given level of achievement. At advanced levels of development the percept remains stable and invariant despite variations in shadow cues.

k. Fluorescent light demonstration. This demonstration is similar to the outside light demonstration, in that a light outside the room throws light and shadows on to the wall. However, in the fluorescent light demonstration, the light directed to the back wall is white, and thus, in addition to changes in brightness and shadow values, there are changes in the color values of the back wall. The results are similar to those in the previous demonstration.

l. Light variation demonstration. The standard illumination for the room is provided by (*a*) a light source suspended in the cubical section in a special ground-glass diffusing mechanism, whereby proportionately more light is directed to the distant part of the back wall than to the near part (to make up for the increased distance to the far part of the wall) and (*b*) indirect lighting directed through the space on to the back wall. Both are controlled by a variac. In the light variation demonstration the illumination is increased, decreased, or varied up and down consecutively by varying the standard setting on the variac. Therefore, increases or decreases in illumination do not change the brightness relationships on different parts of the back wall, but just change the total brightness value; i.e., the back wall gets either brighter or dimmer than standard illumination.

The *S* at first perceives the back wall as "flapping back and forth"; i.e., as going farther away and nearer. An increase in illumination is perceived as a cue to distance (and then the wall flaps farther away), while a decrease in illumination brings the wall nearer. This apparent contradiction to the traditional brightness-distance relationship is resolved when we understand how *S* actually perceives the increases and decreases in illumination. An increase in illumination not only makes the back wall brighter, but fills up the space and the wall "moves back a little to let the light in." However, at times the "light-filling space" cues are not potent enough and the room remains square, while the variation in illumination is perceived only as a variation in brightness.

With increasing development the perceived space influences the perception of parts of the wall in the direction of veridicality. When *S* relates the window to the perceived orientation of the back wall (i.e., perceives the size and shape of the window in relation to their angle of orientation), the development of veridicality is facilitated. At advanced levels of development the room is perceived as distorted and an increase in illumination is perceived as an increase in brightness. Thus as veridicality and stability are achieved, the perceived structure of the room remains constant despite variations in environmental stimulation.

B. Transfer Experiment

In this experiment Room 1 distorted section is rolled away and Room 2 distorted section is moved into position in front of the cubical section which remains identical. While Room 1 is distorted out toward the right; i.e., the large gap is on the right side and the windows are trapezoidal with the widest side on the right, Room 2 is distorted out toward the left (compare Figs. 3, 4, and 5, 6).

When we come to the transfer experiment, *S* has experienced the long training program provided with Room 1 and has developed a new mode of perceiving Room 1. At the start of the training experiment, *S*-2, for example, perceived Room 1 as a cubical room; throughout the training there was a long and gradual development toward veridicality; and finally at the end of training *S* perceived Room 1 as it objectively was. In other words, *S* in the transfer experiment is not the fresh and naive *S* who has never previously experienced a distorted room. The *S* in the transfer experiment has built up a new perceptual and motor adaptation to the first "experimental world" we provided him. The questions we now raise are: What has *S* learned in Room 1? When *S* is confronted with Room 2, what will carry over from Room 1? How will *S* adapt to this second "experimental world" we provide for him; i.e., Room 2?

1. *Posttraining series in Room 1.* Since five months had elapsed between the end of the training experiment and the beginning of the transfer experiment for *S*-2, she was placed before the training room again (Room 1) to see how much of the previous learning had been retained. As was expected, *S*'s first perceptions of Room 1 after five months were not like her veridical perceptions at the end of the training experiment.

There was a compromise effect; the total structure of the room was perceived neither in terms of veridicality (i.e., distorted), nor in terms of the proximal projection (i.e., square). Moreover, when the objects or cue-demonstrations were placed in the room, they were not perceived as they naively had been perceived at first, i.e., as distorted, nor were they perceived as they were at the end of the training experiment; i.e., as constant. A regression from veridicality had taken place; the objects were not adequately related to the framework of the room. Therefore, several hours of further practice in viewing the various objects in Room 1 was undertaken in order to help *S* develop veridicality again. However during this posttraining series the perceptual achievements of *S* were unstable and there was considerable fluctuation in the perceptual outcomes at various times. Concomitantly, motivational difficulties were apparent and it was consequently considered expedient to attempt to investigate the nature of these difficulties. For several hours *S* freely expressed her feelings about the experiment. The *S*, having previously worked quite hard to perceive the room as it was objectively, and having achieved this goal of being "in contact with reality," now presented some considerable resistance to the experiment. Her drive to perceive reality and her curiosity to see the unknown had been satiated. The *S* became frustrated with the repetition, and stated that she had reached the limits of her ability to learn in the present situation. She said that if there were only something new in the experiment, some new problem or puzzle which she could attempt to solve, she would be able to start out fresh and continue to explore the experiment with *E*. Consequently, because of these motivational considerations, even though *S* had not fully redeveloped a stabilized veridical percept of Room 1, the posttraining series was discontinued. Between sessions *E* placed Room 2, the transfer room, in position and thus provided a "new problem" for *S* to solve. Thus, unknown to *S*, the next session she looked into Room 2, just as she had on previous occasions looked into Room 1.

2. *The transfer room.* At the beginning of the session the cigarette package

rests in the center of the upper string in the cubical section, while the back wall is completely bare. Not only does *S* perceive the room as square when the room is objectively slanted out to the left (at times there is some ambiguity and *S* even perceives the room in the direction of Room 1; i.e., slanted out to the right), but she also misinterprets the cue "built-in" to the cigarette package cord. In terms of perspective relationships, the cord on the back wall gets narrower toward the left side as it moves into the distance along the back wall. Not only does the possibility of utilizing the narrowness of the cord as a cue to the distance and slant of the back wall remain unrealized, but even though the cue is noted by *S*, it is misinterpreted, and the wall is perceived as being "farther away on the right-hand side."

E: All right; close your eyes a minute while I set up the next demonstration. (Long pause.) (The lower package is placed on the left side of the back wall.) All right, open your eyes. (Pause.) (The lower package is moved from L to R.)
S: Hey, there's something wrong! (The lower package is moved from R to L.) Hmm, I've been had. The wall's tilted the other way!
E: How can you tell?
S: Well, I can tell the way the cigarette package moves. Move it, see if it will go on beyond the wall.
E: Well, let's look at the other cigarette package. (The upper package is moved L and R inside the cubical section.)
S: Well, that's just as it always was, I think.
E: (The lower package is moved L and R.)
S: Umm, I can't figure it out. The wall doesn't look tilted that way. You can't bend the thing in the middle can you? It can't be tilted away though on the right, because I saw the cigarette package. (Pause.) Hmmm. (Long pause.)
E: All right, I'll move the cigarette packages again. (Upper and lower packages are moved L and R.)
S: It has to be tilted away. I'm sure it has to be because that cigarette package looks just the opposite as it did before when it slanted downhill to the right—now it does the same thing to the left. (Short pause.) And it looked better to me today than it did yesterday.
E: Better? How?
S: Well, I've seen space over on the right—I thought I was. (Short pause.) I give up.
E: You give up. Why?
S: (Laughter) I'm completely confused now. The way I can see it, it looks better today—apparently just backwards.
E: Um-hmm. Let me move the cigarette packages again. (The upper and lower packages are moved L and R.)
S: I don't see anything, except that they're much farther apart down at the end. Ummmm—(Pause).

The perception of the wall in the frontal plane (or slightly slanted out to the right) and the perception of the cigarette package moving into the distance toward the left immediately presents a conflict to *S*. However, the conflict is not resolved in the direction of distorting the perception of the package, as in the initial perceptual outcome in the training experiment. On the contrary, the package is perceived as it objectively is; i.e., moving downhill into the distance. That the conflict is not completely resolved, however, is reflected in the lack of relating the perceived qualities of the package with the perceived nature of the back wall. Even though the package appears to be moving out toward the left, and therefore the wall "has to be tilted away toward the left," the wall does not immediately look tilted that way. The *S* still believes the wall to be the Room 1 wall, since the window frames appear rectangular or slightly trapezoidal to the right. Only when other cues for the perception of the window frames are subsequently presented does *S* integrate the perceived orientation of the wall with the new shape of the window frames. It is this lack of integration which presently provides for the feelings of frustration and confusion. Also interesting is the fact that the objective nature of the moving package is perceived "better today"; i.e., *S* not only carries over the operation of

perceiving the moving package as moving-into-the-distance, but perceives it even better in a new situation, where the satiation effect has not yet set in. This suggests that there may be important relationships between the nature of the perceptual outcome and the motivational setting in which is occurs.[5]

E: All right. Close your eyes a minute while I set up the next demonstration. (The designed cards are placed along the tops of the window frames.) Open your eyes.

S: Well, I guess it's tilted away to the left. (Pause.)

E: How do you guess?

S: Umm, the cards look as if they're—well how do they stand up? The thing looks like it's reversed. I don't see how you can do that unless you have two walls. Yeah, it is! That right window is smaller! (Pause.) No wonder I couldn't see a peak up in the corner.

E: A peak, what do you mean?

S: I looked for that peak up in the right hand corner and I didn't see it. But I didn't see that there was one in the left hand corner. (Pause.) I couldn't see that at all when I looked in. It's very plain now that the windows are reversed—that the small one is on the right. They even look like trapezoids.

E: They look like trapezoids.

S: Um-hum.

E: Can you tell me something—how you first saw them as trapezoids?

S: When you put the cards up.

E: Yeah, what happened?

S: Well, then I saw that they slanted up and away to the left. And then I saw that—well I really took a good look at them then I guess—maybe then it dawned on me that the left one was larger and that the wall is really reversed, you know, completely.

E: Before I put the cards up you thought that the wall was tilted out on the left but it was still the same wall?

S: Um-hum, yeah, that's what I thought. (Pause.) And I was sure those two cigarette cords were farther apart over there on the right, and they're not at all.

When the possibility of there being two walls is recognized and accepted by *S*, the development toward veridical perception proceeds at a rapid rate. The addition of the cards to the tops of the window frames very quickly facilitates veridical perception of the room; i.e., the wall is perceived as tilted out toward the left and the windows are perceived as trapezoidal toward the left, the left one being larger than the right. As with the cigarette packages, the cards are not perceived as distorted to fit in with the perceived rectangularity of the window frames, as in the beginning of the training experiment. In striking contrast, in the transfer experiment the cards maintain their objectivity and serve as a standard for and are integrated with the perception of the window frames. The advanced level perceptual functioning acquired in Room 1 is utilized and adaptively generalized to the new distorted room. The development toward veridicality is attained at a rapid rate in the transfer room and much earlier than in the training experiment. Comparable levels of achievement were reached within one hour in the transfer experiment as compared to approximately 20 hours in the training experiment.

E: All right. Close your eyes. (The cards are taped below the edges of the bottoms of the window frames.) (Pause.) Open your eyes. What do you see now?

S: Two rows of cards instead of one. Slanting away to the left. (Short pause.) That's funny, I can see it better—or maybe it's the cards that make it easier to see. But I can see it better this way than I did the other way now.

E: Um-hum. In what way can you see it better?

S: Well yesterday—or whenever we started this thing, I don't remember how many days it

[5] This is not the place to discuss the role of motivation in perceptual learning, but the following may be noted. Under high motivation *S* appears to become less distractible and becomes sensitized to the cues and thus becomes better able to utilize a given cue-organization. He becomes more goal-directed. When an *S* undergoes strain, he probably is attempting to keep out the distracting aspects of the situation. There is a conflict of cues, and *S* has to resolve the conflict by relegating certain cues (perspective cues) to the background by giving less potency to them. When he exerts more effort, he attempts to give certain cues (object cues) more potency.

was—but when you put those cards on the bottom it didn't do a thing to those windows —nothing at all. But it does when you do it this time.

E: Um-hum.

S: Not so much for the left one as it does for the right one. The right one, I can see the slant of that one very clearly, even down at the bottom. I mean I think I can—that's the way it looks to me, but the room looked one way to me when I first looked in today and now it's another way, so I'm kind of not sure. Anyway that's the way it looks. (Short pause.)

E: All right, close your eyes again while I set up the next demonstration. (The cards are taped to the left side of the left window and the right side of the right window.) All right, open your eyes again. (Short pause.)

S: Some more cards. Yeah, these on this side are very much closer to me than the others— I mean the ones on the right side are closer than the ones on the left.

Similarly, the addition of the cards on the bottoms and sides of the window frames is readily integrated with the almost completely developed veridical perception of the room.

During the remaining parts of the transfer experiment, the other cue-demonstrations were presented. For example, when *E* walked into the space, there was no perceived strangeness of the person, nor was there any reported change in the appearance of the room. This provides another contrast to the initial perceptions in the training experiment (see man and chair demonstration) where the perceived size of the person changed and where the overlay cue provided for the increased awareness of the space and distance. This part of the transfer experiment is, thus, quite similar to the highly developed aspects of the training experiment. A degree of stability and veridicality has been reached in the transfer experiment in which the perceived structure of the room remains fairly constant despite variations in the environmental stimulation, denoting the rapid utilization of advanced levels of perceptual functioning.

E: All right, here's the pointer. Try to point to the upper right-hand corner of the room. (Pause.) Now the upper left-hand corner of the room. How did it feel when you reached the point?

S: Well, it was a little bit— I underestimated it a little bit on both corners, but not—uh, I didn't feel lost, but I just didn't quite see it accurately.

E: O.K. Try tracing out the window panes with the pointer.

S: I'm just trying to get my arm out. (Short pause.) I can't (laughter).

E: You can't what? (Short pause.)

S: I can't coordinate what I just saw with what I've been doing. I'm awkward.

E: What seems to be the trouble?

S: Well, I learned to follow that other outline so well I could do it without even looking at it, you know, and uh, this, even though I saw it turned away, when I take hold of this pole I still want to trace the old pattern, you know. I may have seen something, but it hasn't communicated itself yet. I don't think that makes very good sense. This is kind of left-handed work or something—it's kind of backward or something. Well, that's funny. I can see it that way but I can't uh—maybe I'll learn to—I don't know.

E: (The *S* practices pointing at various parts of the back wall.) How does it feel now that you've had an opportunity to practice with the stick?

S: Well, it isn't so bad. I haven't lost myself, but I still want to go the other way, you know just out of habit.

The *S*'s initial motor behavior in the transfer experiment is not well-coordinated with the percepts. However, it is not that *S* is "lost," as in the beginning of the training experiment, but that *S* carries over the specific motor habits from the "old pattern" which are ill-suited to the presented differently-shaped transfer room and which lead to maladaptive motor behavior. The *S* notes the strangeness of the situation in which she "can see it that way" (i.e., tilted out to the left), but this veridical percept is not communicated to her motor adjustment. Thus, the carrying over or transfer

of specific motor habits from the previous training at first leads to maladaptive consequences in a new situation, since the old behavior is no longer applicable to the new distorted room. The *S* has to learn new behavioral habits in the new distorted room.

When other cues were presented, veridicality was maintained: (*a*) When the ruler was passed along the back wall; (*b*) when the back wall was moved in an arc so that the angle of orientation was increased and decreased; (*c*) when shadow and illumination cues were presented; (*d*) when the cards were removed from the window frames; (*e*) when the cigarette package was removed from the back wall. Throughout all these changes in environmental stimulation, the room was perceived as it objectively was and remained invariant. In addition, *S* could not see the room as square with rectangular windows when she attempted to do so. These perceptual outcomes denote the utilization of levels of perceptual functioning similar to those utilized during the advanced stages of development in the training experiment.

However, while advanced-level perceptual functioning was adaptively utilized and very early resulted in the achievement of veridicality, the total consolidation process involved in newly-developed percepts may be a somewhat slower and more gradual achievement which comes about through increasing contact and familiarity with the stimulus material. For example, with *S*-2, while a considerable amount of stability had been attained early in the transfer experiment, this stability later broke down, and during later hours the perceptual outcomes were variable and veridical perception was not always attained. The situation was, however, again complicated by motivational considerations, since satiation effects similar to the effects in the post-training series were manifested. Thus, the rapid generalization process may be contrasted with the gradual consolidation process in which various relationships are integrated and stabilized.

V. Discussion

The *S* looked into Room 1 at the beginning of the experiment and reported a square room with rectangular windows of equal size. In order to investigate how adults could learn to perceive the veridical nature of the distorted room, we provided *S*s with the opportunity to view objects and people as they moved about in the room and also to manipulate a stick and touch various parts of the room with it. For example, one object, a cigarette package, was attached to the cord on the back wall and was moved along the length of the wall. Since the back wall was at a 24° angle of orientation to *S*, as the cigarette package moved along the wall it moved toward or away from *S*. This situation in the distorted room produced an impressive deviation from size constancy. As the cigarette package objectively moved toward or away from *S*, it was perceived as either growing or shrinking in size and moving across the frontal plane. The same object was perceived as changing in size but at a constant distance from *S*. It is not surprising that this occurred, since with the room perceived as square, the wall was perceived to be in the frontal plane. Distance was the invariant and size was perceived as varying with retinal angle. Since the cigarette package as it moved toward or away from *S* changed in retinal size, it was perceived as changing in object-size. When the package was at the far end of the back wall, the package subtended a retinal angle much smaller than the package in the near corner of the room, and it was therefore perceived as abnormally small. Differences in retinal angle were perceived as differences in object-size and not as differences in distance.

As the experiment progressed, more and more objects were introduced into the room. Other objects underwent distortion similar to the distortion of the cigarette package when it was perceived in the context of the square room. For example, the designed cards were distorted in shape and size; i.e., objectively they were rectangular with square designs, but they were perceived as crooked with diamond designs. Rectangular and trapezoidal poster cards placed in the room also were distorted in shape and size. A man walking into the room changed size as

he moved along the back wall. A yardstick grew and shrank as it is moved along the back wall. A marble rolling down a trough along the back wall was perceived as rolling uphill, and so on. (This last demonstration was used only with *S*-3.) These distortions brought about conflict in *S*, i.e., a conflict between perceiving the distortion of the room and perceiving distortion of the objects. The conflict was initially resolved in the direction of distorting the objects in the room and, as a consequence, the usual constancies and causal relationships of everyday life broke down. When more objects were provided and when *S* performed inadequately in judging the distance of different parts of the room with the stick, more contradictions were presented, and therefore motivation to attempt to bring about some kind of resolution of the conflict and to bring harmony into the perception of objects and room was increased. This was especially evident when a human being walked into the space along the back wall. People possess a constancy that is important for our interpersonal relationships with them, and therefore it was quite difficult to intellectualize or rationalize the perceived size changes of the person as he moved about the room.

A. The Percept Began to Change

As the experiment progressed, changes in the retinal size of the object began to be perceived not as changes in the size of the object itself, but in terms of cues to changes in the distance of the object. There was a gradual trend toward perceiving the object as constant-in-size-at-a-given-distance. Similarly, changes in retinal shape began to be perceived not as changes in the shape of the object itself, but in terms of cues to changes in the position or orientation of the object. There was a gradual trend toward perceiving the object as constant in shape-at-a-given-orientation. In both cases there was a change in perceptual attribution, with the varying aspects of the retinal distribution being attributed to the spatial surroundings of the object instead of to the object itself. Instead of referring retinal variations to the object, *S* referred them to the distance and position of the object. Relating the object to its spatial surroundings and taking into account the object's distance and orientation helped to bring about veridical perception of both objects and room. Thus object-constancy was not developed in isolation. The object and the surroundings developed mutually; as object-character developed enough potency to serve as a cue to its position in space, the position in space affected the nature of the object-character. As object-cues were given increasing potency, the nature of the object became the invariant, and the spatial surroundings became the variant to which the object was related and coordinated. Finally, veridical perception of both object and room was achieved.

When we say that objects were perceived in terms of the perceived squareness of the room, this means two things: First, that *S* perceived the room in terms of the perspective relationships built into the room, and second, that the objects were perceptually embedded in the framework of the perspective relationships of the room, or else the objects would not be perceived as distorted. Therefore, to utilize object-cues, *S* had to differentiate retinal variations of the object from the perspective relationships built into the room. The *S* had to perceive the object independently of its surrounding framework, so that it could be adequately related to the framework and thus serve as a cue to the nature of the spatial context. The retinal variations could then be referred not to the object itself, but to the spatial context of the object. It was, therefore, an independence without isolation, since by referring the object to the spatial context, it could influence the perceived structure of the spatial context. When the object was perceived as a segregated entity, it was not related to, nor did it serve as an anchorage for the spatial surroundings.

The relationship of the object-cues to the spatial framework was, however, a reciprocal one. As the spatial framework itself became more articulated and better defined in terms of its objective nature, it in turn influenced the perception of the objects in the room. That is to say, the development of the spatial framework toward veridical perception facilitated the development of object constancy, since when an object could be localized in the spatial framework, it could then be perceived as constant-at-a-given-distance-and-orientation. As the object developed constancy it could reciprocally be increasingly utilized as a cue to the structure of the spatial framework, and then the developmental cycle began over again. It was through increasing differentiation of objects and framework and yet progressive integration and coordination of objects and framework that veridical perception was facilitated. These conceptions of development in terms of differentiation and integration may be compared with similar ones developed by Baldwin (4), Murphy and Hochberg (14), Piaget (15, 16), and Werner (20).

The problem of learning to utilize retinal variations of objects as cues to the nature of the room, and reciprocally, as cues to the nature of the object itself therefore also was a developmental process. In other words, the cues that helped *S* develop veridical perception of the room and objects were not "given" to *S*, with S

being only a passive recipient who incorporated the cues into his percepts and somehow accommodated himself to the room. The *S* had to assimilate himself to the room by actively disclosing and discovering what the cue value of the object was.

The utilization of object-cues did not have to be a process that developed with full knowledge of the usual and familiar characteristics of the object. If an object moved in space, a completely unfamiliar object could be utilized as a cue to distance and position. For example, as an object moved along the back wall toward or away from *S*, retinal size continually changed with distance. The *S* needed only to perceive thing-identity for changes in retinal size to serve as a cue to changes in distance. That is to say, an object remains the same object and does not become enlarged or contracted as it moves about in space, and therefore changes in retinal size had to be due to changes in distance. (The question of how thing-identity emerges in nascent perception is a long and complicated process itself that takes us beyond present experimental considerations, but it could be assumed to be operative in adults in the present experiment.)

It was through coordinating and interrelating retinal variations of the object as it moved about that *S* could determine whether the object was small and near or whether the same object was actually large and farther away. This was probably the case in developing veridical perception of the rectangular and trapezoidal poster cards, since they were initially both unfamiliar as to shape and size. However, the utilization of retinal variations of the object as a cue to its distance and position could be facilitated when the objects were familiar ones. With objects of known dimensions, even the object was static, the individual could attribute the known size and shape to the object, and thus utilize known size and shape as cues to distance and position. When the cigarette package, for example, which was familiar in size and shape, appeared to be abnormally small, this could mean that the package was at a greater distance than it actually appeared. However, the process was not simple, nor was it only an intellectual process, since the familiar object still had to be perceptually related and coordinated to the spatial context of the room if it was to be perceptually utilized as a cue. But knowing how an object should look could sensitize *S* to the possibility of its utilization as a cue to the spatial context. It was in this sense that familiar objects facilitated the development of new object-framework relationships.

As *S* increasingly resolved the conflict of cues, the next problem he faced was the development of stability of the new perceptual achievement. Up to now *S* had been able to achieve veridicality by adequately relating the objects to their spatial surroundings through taking into account their distance and position. As the new percept was developing, *S* needed the support of object-cues for this relating and coordinating process to take place. They acted as a standard or anchor from which the spatial surroundings derived their stability. In the early stages of development the loss of the cue-supports could bring about the regression of an advanced-level perceptual achievement. Gradually, however, the newly-developed percepts became consolidated and stabilized. As different parts of the room became increasingly interrelated, they grew increasingly free from the need for cue-support. Finally, a stable level of achievement was reached so that the addition or subtraction of object-cues did not alter the perceptual outcome. The room came to be perceived in terms of its objective nature without any objects in the room. As S-2 stated, after 22 hours of experience she could not even see the room as square with rectangular windows when she had made an attempt to do so.

It appears that *S* developed and perceptually constructed a perceptual stereotype. The *S* developed a particular perceptual response that was elicited when the given stimulus distribution was produced on the retina. Before *S* had the opportunity to obtain various experiences in the room, the given proximal stimulus distribution had given rise to the perception of a square room. In striking contrast, after experiences in the room, the same proximal stimulus distribution gave rise to the perception of a distorted room, a room with a distorted back wall and trapezoidal windows. The stimuli available to *S* were precisely the same; the perceptual outcome was very different. The percept ceased to be uncoordinated with the distal stimulus, and achieved coordination with it.

Thus, the role of experience and contact with the environment was to make the individual more coordinated with the environment. A given proximal stimulus could give rise to a variety of percepts. Among all possible percepts that could be derived from the given proximal stimulus distribution, *S*, having experienced the particular kind of experiences in this particular distorted room, built up a new preferred mode of perceiving, i.e., a Room 1 preference. The percept was altered in terms of the qualitative nature of *S*'s interaction with the objects and room itself, i.e., the environment, and the nature in which his interactions had been integrated into his previous mode of perception.

This last point was further demonstrated with S-3. This *S* had learned to perceive the first distorted room as it objectively was. Advanced per-

cepts became consolidated and perception of the distorted room was stabilized and no longer required cue-support. Immediately afterwards in the next session, without the knowledge of *S*, the differently-shaped distorted room was put into place. This second distorted room had a projection equivalent to that of the first distorted room. Room 2 was presented bare; no objects were present in the room. What happened was that Room 2 was perceived as if it were Room 1. That is to say, Room 2 was perceived as distorted, but distorted in the way Room 1 was distorted. Although this may at first seem surprising, it is understandable since the stimuli that came to *S* from Room 2 were identical with the stimuli from Room 1. In this case the newly-developed preferred percept was Room 1, and when the same stimulus distribution was produced on the retina, it was perceived as Room 1. Thus, the individual's initial interactions with Room 1 provided new experiences which led to a modification of the preferred mode of perception. A new perceptual stereotype was developed which was carried over to the second distorted room. These results corroborate Kilpatrick's experiment (10) utilizing the Ames distorted room, in which he demonstrated the development of a perceptual stereotype and its transfer to an equivalent distorted room.

The question arises: What were the adaptive consequences of this newly-developed perceptual stereotype? With Room 1 *S* perceived the room in terms of its objective nature, so that an equilibrium between the individual and the environment was achieved. However, when Room 2 was put into place, *S* perceived Room 2 as Room 1 and *S* then experienced new conflicts and contradictions. Thus, a new disequilibrium was established. It appears, therefore, that the perceptual stereotype developed in Room 1 was adaptive in the specific situation in which it was developed, and provided for equilibrium *only* in that situation. The newly-developed perceptual stereotype did not provide for an environment-adequate adaptation which remained invariant and stable despite transformations in the spatial context.

B. What Has Been Learned

The next phase of the experiment was to find what *S* had learned in terms of its generality and transposability. After many hours of experiencing Room 1, *S*-2 and *S*-3 had learned to perceive the room and the objects as they objectively were. In addition, the new percepts developed stability and the room was perceived in terms of its objective nature without the support of object-cues. However, several months had elapsed before the transfer experiment with Room 2 was begun with *S*-2, and therefore the perceptual stereotype for Room 1 which this *S* had previously developed had regressed. Therefore, when the transfer experiment was begun, this *S* did not manifest a well-defined and stabilized perceptual preference for Room 1. Consequently, when *S*-2 looked into Room 2 without knowledge that it was a different room, it was perceived as mostly square, but at times somewhat like Room 1. However, in the transfer experiment we were not only concerned with the nature of the manifestation of the perceptual stereotype acquired in Room 1. We were also concerned with the nature of the perceptual functioning that *S*s had acquired in Room 1, over and above the acquisition of a perceptual stereotype.

What was striking was that when objects were presented in Room 2, both *S*s maintained a constant relationship to object-character. When various objects were placed in Room 2, they were not perceived as distorted and in terms of the initial perception of Room 2 as they had been in Room 1 at the beginning of training. For example, at the beginning of the training experiment when the cigarette package was moved across Room 1, it was perceived as shrinking in size instead of receding into the distance. During the course of the training in Room 1, *S* developed object-constancy and the cigarette package was perceived as constant in size and receding into the distance, as it was objectively. In contrast, in Room 2 the cigarette package was not distorted as first it was in Room 1 but was immediately perceived as constant in size and receding into the distance, demonstrating in a striking way the transfer of advanced-level perceptual functioning that had been acquired during the long training in Room 1. Similarly, and also in striking contrast to their initial distortion in Room 1, the designed cards also maintained their constancy in the context of a new situation. Then very quickly the wall came to be perceived at an angle of orientation, and the windows as trapezoidal, and the total structure of Room 2 came to be perceived in terms of its objective nature. The object-cues were quickly coordinated and integrated with the spatial surroundings of Room 2. Thus, Room 2 was perceived in terms of the stable and enduring characteristics of the objects within it.

It appears, therefore, that in addition to a perceptual stereotype *S* had developed a *generalized way of perceiving object-framework relationships*, so that the objects could serve as invariant anchorings and could be perceived as invariant throughout transformation in the spatial context. The new way of organizing the potency of cues acquired in Room 1 was effec-

tively generalized to Room 2 and provided for the achievement of veridicality in Room 2. The newly-learned operation of organizing cues in a certain way was not restricted to functioning in a specific situation and was not tied to specific structural contents. Thus, not only did the newly-developed way of perceiving acquired in Room 1 make for the achievement of veridicality in Room 1; it also was carried over and adaptively utilized in Room 2 and provided for the achievement of veridicality which survived the transformation in the spatial context. The newly-developed way of organizing object-framework relationships provided for a generalized environment-adequate equilibrium, since invariant objects were perceived as invariant; both Rooms 1 and 2 came to be perceived in terms of their objective natures.

These conceptions in terms of the organization of cues may be compared with those of other workers who have considered the process of perception. For example, Ames states that, "The process (which takes place below the level of awareness) by which the innumerable cues are integrated into a perception . . . is not a simple summation of cues. Some cues may not be made use of at all or may be only partially made use of. In this process of integration the use made of cues (or the weight given them) depends upon their prognostic reliability" (2).

Hilgard discusses "how patterns of experienced frequencies determine the interpretation of data present to the senses. A simple frequency theory of perception is like a simple frequency theory of habit formation. Both say that we do in the present what we most often have done in the past. Just as in a word-association test we reply to the word 'day' with the word 'night' because of the frequency of day-night association, so in perception we see the object that the presented cues have most often signified. . . . The main criticism (of a simple frequency interpretation) is that in perception, as in learning, interpretations are modified by the patterns of experienced frequencies and not solely by the totals of such frequencies" (9).

Another investigation dealing with the organization of cues is that of Weiner (18), where *Ss* learned to reorganize the potency of visual and body cues in the perception of the upright. The newly-learned organization of cues led to a change in perceiving the upright and was effectively generalized to a second orientation situation.

C. Perceptual Learning and Unlearning

Up to now we have been dealing mainly with the acquisition of perceptual stereotypes and new ways of organizing object-framework relations. This was not meant to imply, however, that this exhausted the qualitatively different kinds or forms of perceptual learning processes that were possible and that may have contributed to the achievement of veridicality. For example, much of the learning was *unlearning*. "Ignorance," as Mark Twain would say, "is not, not knowing, but knowing things that ain't so." In the training experiment, giving potency to perspective cues in the distorted room maintained the perception of the square room and provided for object-distortion. Only when perspective cues became poor and unreliable cues and were given less potency, could other cues, such as object-cues, be given more emphasis and veridical perception be achieved. As one *S* stated after nine hours' experience in the room, "I almost believe what I see. Before I didn't believe what I saw *because I've learned not to.* . . . All I can say is that's what it looks like now." In other words, concomitant with the learning to give greater weight to object-cues, *S* had to unlearn the usual potency given to perspective cues in everyday life. Similarly, in the transfer experiment *S* had to unlearn the perceptual stereotype built up for Room 1 before new learning could occur in Room 2. The material to be unlearned impeded the learning of the new material.

The data suggest that *S* developed a new "cognitive outlook" which significantly influenced and played a role in his perceptual functioning. For example, in the early stages of development in Room 1 *S* would attempt to cling to his initial perception of squareness by rationalizing or intellectualizing contradictions. As a consequence, much energy seemed to be devoted to this effort and *S* manifested resistance to change. However, when *S* could reckon with the hypothesis that the room could in some way be distorted, *S* could accept contradictions and conflicts as a problem to be solved, and not as something which had to be "held onto" and rationalized. For example, after *S* had attempted to hit the back wall with the stick and was not successful in the attempt, she stated that, "Something must be wrong with the room." If one could emotionally accept the fact that rooms could be of all shapes and, as one *S* explained, if one could take a kind of questioning and open or receptive attitude toward his own percepts, it became possible to accept new ways of integrating stimuli, and therefore, possible to put less stress on perspective cues as a valid cue to the objective nature of the room. Thus, the acquisition of a new cognitive outlook may have influenced the way in which cues were organized.

Perceptual development encompasses *more* than learning to reorganize the potency of cues. Perceptual learning includes an *"openness"* to

new perceptual information, tolerance for exploring new possibilities, and becoming more accessible to new ways of integrating stimuli. This new cognitive outlook also played an important role in the *generality* of what had been learned; i.e., the degree to which the newly-learned object-framework relationships or cue-organizations could be generalized to a new situation. For example, when *S* was initially confronted with contradictions in the transfer room, i.e., Room 2, not only could the conflict be emotionally as well as intellectually accepted, but also exploration of what the conflict was could be undertaken. In other words, even though a particular cue-organization was a means to solving the conflict, the greater task, and one which had general adaptive value, was clarification and definition of what the conflict was. The task of learning a transposable solution to a conflict or problem was thus one of *enlarging awareness of what the conflict or problem really was* so that a particular cue-organization could be utilized in the resolution of the conflict. For example, with a new cognitive outlook toward distorted rooms in general, hypotheses concerning the differently-shaped rooms that might be possible could more freely be entertained. Because many different shapes of rooms were possible, perspective cues again might not be reliable and the possibility of giving object-cues increased potency was enhanced. It appears that *S* learned to enlarge hypotheses about the possibilities of differently-shaped rooms and the potency given different cues. It is this openness to new perceptual information and increased sensitivity which may have helped to facilitate the transfer of the previously acquired way of organizing the potency of cues. In other words, *S learned how to learn,* and this may have served to facilitate the generality of perceptual learning.

These phenomena remind one of certain processes in psychotherapy, where the goals are to help the patient outgrow or unlearn his neurotic tendencies of learning how *not* to learn and to replace these with healthy tendencies of learning how to learn which would have generalized value outside the therapy situation. We also are reminded of Harlow's experiments (7) in which he noted the general adaptive importance of learning how to learn in the solution of new problem-solving situations.

These experiments indicate that defining the nature of the proximal stimuli (the raw data) was necessary, but this was not sufficient for a complete understanding of the operation of the perceptual system. The nature of the dimensions of what was mediated to the individual, i.e., the percepts, was not solely determined by the mediation itself, i.e., the proximal stimuli. To be sure, there could be no perceptual outcome without the proximal stimuli; it was a necessary link between the environment and what the individual perceived. But it was the *organization of the mediational processes* that determined what a given perceptual outcome would be.

D. The Nature of Perceptual Organization

As we saw in the experiments, organization was a mode of functioning, an operation or process that changed and developed with the ongoing experiences of the individual. Different levels of development manifested different ways of integrating stimuli from the environment and *S* gave different potencies to the different cues at these different levels. Thus, different levels of development possessed different modes of organizing the proximal stimuli, i.e., different organizing principles. The nature of the organizing principle affected the nature of the perceptual outcome.

Therefore, organizational processes were developing operations, and not preformed percepts or structures, or fixed patterns of operations, or static processes that emerged without a history. Perceptual development was understood as reorganizations of proximal stimuli and included new and developing operations in the perceptual system. Perceptual development did not imply only a quantitative increase or change of percepts, but also a development or a reorganization of processes.

In the development of the individual's perceptions, interaction and experience with the environment modified and transformed organizational processes and percepts. Interaction with the environment implied that the individual did not passively accommodate himself to the actions of the physical energy distributions impinging on the retina. The environment acted on the existing developmental level of the organizational processes in the individual; the impacts of surrounding stimuli did not act in isolation, but acted by helping to modify the individual's action on the environment. Thus, in the construction of ever more complex and articulated percepts, we should not expect to find the role of experience and organizing activities separated. We should not expect to find "experience" without a process of experiencing carried out by an *actively organizing individual.* A given organizational process could be modified by new experiences, and experiencing could be modified by the existing organizational process. It was an interaction of mutual dependence. Interaction with the environment helped to make the individual more coordinated with the environment

by affecting the organizational processes, and the nature of any further interaction between the individual and the environment itself was affected by the processes of organization. These conceptions may be compared with the more extensive formulations of Piaget (15, 16) in his discussion on assimilation and accommodation.

For example, the perceptual and motor interaction obtained in the training program in Room 1 provided for the development of new percepts which were more coordinated with the objective nature of the distorted room. But beyond the development of these new percepts, *S* developed new forms of perceptual operations; i.e., new object-framework relationships. These new organizing relationships in turn provided for the emergence of new percepts not only in the situation in which the organizing relationships were developed, but in a new situation (i.e., both in Rooms 1 and 2). Thus, interaction in the room brought about the development of new organizational processes, and reciprocally, the organizational processes affected the nature of the perceptual outcome. Organizational processes were affected by and affected the nature of the individual's interaction with his surroundings.

How organization theory is utilized in current perception research is demonstrated by Klein's (11) "cognitive attitudes" and Witkin's (22) "perceptual modes," whereby they mean an individual's preferred style or principle of organizing a complex of stimuli in terms of early-developed and widely-generalized needs of the personality structure. For example, in Witkin's research systematic variations in perception were noted both developmentally (i.e., differences in perception varying with age) and interindividually (i.e., differences in perception between individuals of the same age) along the field-dependent–field-independent perceptual dimension. It appears that at the field-dependent end of the dimension, there is a relative lack of differentiation between body awareness and visual field; whereas at the field-independent end of the dimension, the body awareness has been differentiated from the visual field, but it has been given undue weight in the final integration of the body and the visual field. With most *S*s there is a differentiation and yet an adequate integration of bodily and visual cues, so that neither extreme of the dimension is reached. Witkin's research suggests that a particular organizing principle develops from the total life experiences of an individual and forms the basis for a particular integration of bodily and visual cues.

Thus, it may be suggested that differences in perception are due to differences in the organizing processes in different people, either because the process has been arrested at a given level of development, or because certain functions in a given process-pattern are given undue weight. This is especially noticeable in the perception of people where an individual's perception of an interpersonal situation may be distorted or constricted because of the nature of the existing organizational processes as they have developed in the life experiences of the individual. In other words, one way of considering the perception of people is that a percept may be environment-inadequate because a certain kind of organizing principle in the individual leads to distortions or impoverishments of the stimuli that may be available to him.

A psychophysics of perception is necessary for an organizational theory, but it is not sufficient. The stimulus conditions do not define the total operation of the perceptual processes; they do not define the nature of the organism's response to or integration of a given stimulus complex. Thus, organization theory does not, on the one hand, deny the importance of stimulus conditions, such as the orderliness of the stimulus field, stimulus gradients, and figural properties (6, 19). Nor does organization theory, on the other hand, deny the importance of experiential conditions, such as attitudes, expectancies, and motives (2, 18). Organization theory is a developmental field theory whose processes are dependent on *both* the operation of stimulus factors and experiential factors. Cf. Attneave (3) for a discussion of these factors in relation to economical principles.

These considerations raise a methodological point concerning experiments dealing with veridical perception. For if we examine cases of veridical perception, i.e., cases in which the percept is coordinated with the environment, we find out only this fact: namely, that the percept *is* coordinated with the environment. We disclose the nature of the organism's achievement. *But how this environmental-adequacy is brought about, and on what processes it is based, can be disclosed by investigating inadequacies.* In the following discussion we shall attempt to develop some concepts put forth by Heider (8).

An analogy may help us here. If one looks through a transparent pane of glass, one finds out about the objects on the other side, but not about the glass itself. When the pane does not simply mediate what comes from the other side, that is, when it is not a pure medium, like air, then one finds out about the pane itself. For example, when one touches the glass with one's hand, then one can get information about the pane itself. This is also the case when it is possible to see it from the side or when there is some defect in the glass. In a similar manner, percepts act as a medium between the environment and the underlying perceptual processes. The more the percepts seem to mediate the environment, i.e., the purer the medium, the less

one can find out about the properties of the perceptual system. Then one finds out about only the properties of the environment. Only when the percept is a poor medium, and when it is environment-inadequate, then we do not find out about the environment but about the properties of the perceptual system.

We may represent these schemata in the following way. A percept *(P)* has its sources partly in the processes of the perceptual system *(p)*, and partly in the environment *(E)*. When *P* and *E* are coordinated, one finds out about *E*. However, when *p* produces inadequate *P*, one can get information about the properties of *p* from the nature of the distortion if one has independent knowledge of *E*. Those features of *P* which are not coordinated with *E* must have their source in *p* itself. Thus, when *P* and *E* are not coordinated, one infers from the effect *(P) to the* underlying cause *(p)*. It is in this manner that inadequate perception may reveal the processes of the perceptual system.

In our investigation we attempted to follow these conceptualizations as a methodological guide for experimental design. Consequently, a stimulus condition was set up so that initially *S* would manifest environment-inadequate perceptions. In this way we were able to learn, first, something about the structure of the perceptual system, from the nature of the initial perceptual inadequacies and how *S* related to the visual environment under these conditions. Second, we were interested in *S* as a developing and growing organism, not as a static being fated to his own distortions. How environment-adequacy was brought about, and on what processes it was based, we could find out by investigating the ongoing processes of *S* in his attempt to construct a percept that would form a harmonious and conflict-free relationship with the environment. It is believed that future investigations directed toward the nature of the organizational processes at various levels of development may more adequately define the nature of the individual's response to his environment; i.e., the nature of his perceptions and his interactions with his surroundings.

VI. Summary

The present study was concerned with how adults develop new visual percepts and new modes of perceptual functioning. For this purpose a room specially designed for this study was constructed in which *S* would initially manifest maladaptive perceptual and motor behavior. For example, the initial perceptual outcome when *S* viewed the bare experimental room was a cubical room, when in reality it was distorted. In addition, when the situation was made more lifelike by placing objects within the room, *S* was immediately confronted with a conflict. There was a conflict between perceiving the distortion of the room and perceiving the distortion of objects in the room. The conflict was initially resolved in the direction of perceptually distorting the objects.

In order to investigate how adults learn to adapt to the strange and unfamiliar "experimental world" of the distorted room (i.e., to perceive the room and objects as they are in reality), we provided *S*s with the opportunity to have a variety of perceptual and motor experiences with the people and objects in the room. While viewing the objects from varying perspectives in relationship to the background of the room, the three *S*s intensively studied in this experiment very gradually developed (after 25 to 40 hours) a new perceptual adaptation to the "experimental world" which we had provided them. A new constancy of objects was developed. For example, initially when a cigarette package was moved along the length of the distorted back wall, it was perceived as shrinking in size, instead of receding into the distance as it was in reality. After experience in the room *S* came to perceive the cigarette package as maintaining a constant size and moving away from him at a slanted orientation along the slanted back wall. Thus, the perceptual outcome was that various same-sized objects at different distances came to be perceived as same-sized objects at different distances, as they were in reality, and not as different-sized objects at equal dis-

tances, as they were perceived before the experiences in the experiment. The *Ss* learned to perceive the intrinsic properties of the objects and concomitantly, the intrinsic properties of the room. The distorted room came to be perceived as it was in reality, that is, as distorted. Veridicality was achieved for both objects and room.

The next problem was: What has *S* learned in terms of its generality and transposability? To answer this question, two of the three *Ss* were presented with a differently-shaped distorted room, but having a projection equivalent to that of the first distorted room. The same objects provided in the first room also were presented in the second room. Under these conditions *Ss* maintained a constant relationship to object-characteristics. They did not have to go through the slow step-by-step developmental process as in the first distorted room. The second room was quickly perceived in terms of the stable and enduring characteristics of the objects within it. Thus, *Ss* carried over the object-framework organizing principle developed in the first distorted room to the second distorted room. The perceptual functioning or operations acquired during the perceptual interactions in the first room provided for an adaptive orientation which survived a transformation in the spatial context; i.e., the newly-developed perceptual processes were adaptively utilized in a new situation.

Throughout the research an attempt was made to analyze the detailed phenomenological protocols not only in terms of the developing percepts but also in terms of the developing processes and new modes of perceptual functioning. The problem of object-constancy and its development was considered in relation to object-framework relationships. The implications of the results for an organizational theory of perception also were discussed.

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